MICROGRAVITY AND MATERIALS PROCESSING FACILITY STUDY (MMPF) - REQUIREMENTS AND ANALYSES OF COMMERCIAL OPERATIONS (RACO)

PRELIMINARY DATA RELEASE

(NASA-CR-179309) MICROGRAVITY AND MATERIALS PROCESSING FACILITY STUDY (MMPF): REQUIREMENTS AND ANALYSES OF COMMERCIAL OPERATIONS (RACO) PRELIMINARY DATA RELEASE (Teledyne Brown Engineering) 693 p CSCL 12A G3/29
N88-18742
Unclas
0129667

CONTRACT NO. NAS8-36122

MARCH 3, 1988

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NOTE

This material is presented to provide the customer the status of the requirements and analyses of commercial operations (RACO) and should be treated as preliminary information. Refinement of the material will continue throughout the duration of the study.

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INTRODUCTION

The information in this requirements and analyses of commercial operations (RACO) study data release reflects the current status of key study activities ongoing, under Modification No. 21 to NASA/MSFC Contract NAS8-36122. This release has been directed by the COR in support of the commercially developed space facility activity.

This document contains information that has been collected and developed to assess the utility of intermediate commercial carriers to pave the way to Space Station in satisfying the flight requirements of the commercial program. The following sections are included:

1. Experiment Descriptions. This section contains descriptions of the 65 identified experimental facilities utilized in the study.

2. Experimental Facility Data. This section contains hard-copy reports of the R:BASE™ electronic data base being used in the study, synopses of the experimental facilities, and summary data on the facilities.

3. System Requirements. This section provides a discussion of video and data compression techniques as well as mission timeline analyses.

1. EXPERIMENT DESCRIPTIONS

This section contains descriptions of the experiment facility/payloads used in this study. The payloads were selected based on the following criteria.

1. They are material processing in space (MPS) type experiments.
2. They are existing, being developed (under construction), or being defined (Phase A or B definition).
3. They are commercial, academic, NASA, or other Spacelab/Shuttle payloads.

From this, 65 payloads were selected. These payloads are the representative set of experiments from which the commercial carriers have been analyzed. This analysis determines the interface, system level, and logistic requirements for various commercial endeavors.

Facility/Hardware Name:ACOUSTIC CONTAINERLESS EXPERIMENT SYS. Abbr:ACES NASA Code:EN NASA Center:JPL

Development Status:D
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:NASA SPONDORED PI's

Purpose:FLIGHT FACILITY THAT WILL MELT AND ACOUSTICALLY OSCILLATE A SINGLE SAMPLE OF GLASS, CERAMIC, OR METAL. FACILITY USES A RESISTANCE HEATED INCONEL CHAMBER FURNACE.

Abstract:THE FURNACE IS AN INSULATED RESISTANCE HEATED INCONEL CHAMBER OF 6.3 BY 6.3 BY 7.0 cm INTERNAL DIMENSIONS. THE ENERGY OF THREE AXOUSTIC DIRIVERS ENTERS THE CHAMBER THROUGH THREE ORTHOGONAL PORTS AND FORMS RESONANT STANDING WAVES WITHIN THE CHAMBER TO RESTRAIN SAMPLE EXCURSIONS FROM THE EFFECTS OF EXTERNAL PERTURBATIONS. RESONANT FREQUENCY IS TRACKED THROUGH THE CHAMBER TEMPERATURE CHANGES AND ADJUSTED TO MAINTAIN RESONANCE AND SAMPLE LOCATION CONTROL. ROTATION AND OSCILLATION OF THE SAMPLE CAN BE PROGRAMMED INTO THE EXPERIMENT.THE EXPERIMENT IS MONITORED BY THERMAL SENSORS AND A VIDEO RECORDING SYSTEM DURING THE 120 MINUTE DURATION WHICH PROVIDES ABOUT 15 MINUTES AT THE PRESENT LIMITATIONS OF 620 C.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 900.000(Max) to 20.0000(Min) with a Maximum Temperature Delta of 880.000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:GLASS, CERAMIC, METAL
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) :-0- Height x-u- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:Acoustic Levitation Furnace Abbr:ALF NASA Code:na NASA Center:na

Development Status:D
- A = Under Study
- B = In Definition
- C = Being Fabricated
- D = Existing Hardware

Sponsor:Japanese Space Agency

Purpose:The ALF holds a spherical sample at the elliptical mirror focus by acoustic levitation. The purpose of the ALF is to explore the feasibility of preparing superior glass materials.

Abstract:The space environment is unique in providing microgravity and capability of containerless processing. The ALF provides the control equipment and levitator which has the capability to hold a spherical sample at the elliptical mirror focus by acoustic levitation. The levitation process is fully automated. Levitation control is performed in three transition states; levitation mode, heating levitation and cooling mode. The purpose of the experiment is to explore the feasibility of preparing glasses exhibiting superior transmittance in non-visible, particularly infrared region. The containerless melting eliminates extraneous contamination by crucible wall materials. Glasses of the CaO-Ga2O3-GeO2 system are selected by examining the melting temperature, devitrification, infrared transmission. The product is a bead about 7mm in dia.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1400.00(Max) to 25.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Calcium, Gallium, and Germanium Oxides
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 0.10000 Height X 0.10000 Width X 0.10000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 0.88800(Max) to .1000E-5(Min)

Facility/Hardware Name:Ad. Automated Directional Solidification Abbr:AADSF NASA Code:IC/EN NASA Center:MSFC

Development Status:C
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:NASA Sponsored PI's Code E and I

Purpose:Modular, multizone Bridgman furnace to grow single crystals of compound or alloy-type semiconductors by directional solidification of the composites.

Abstract:The AADSF, a sophisticated direction solidification furnace with a controlled grdient region between its hot zone and cold zone, will be used as a primary facility for processing a wide varity of commercial materials including electronic and magnetic materials, metals, and alloy. The AADSF is a reconfigurable, modular furnace that can be customized for particular experiments; it is the forerunner of a set of furnaces being developed for the Space Station. Investigators can use the AADSF to examine gravitational limitations on melt growth of alloys and effects of density/gradient-driven convection on crystal homogenity and defect density. A better understanding of these phenomena is necessary to improve processing on Earth and to develop more complex space processing facilities for the Space Station.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1600.00(Max) to 200.000(Min) with a Maximum Temperature Delta of 900.000(deg C)
Maximum Cooling Rate (watts): 800.000
Translation rates (if applicable in mm/hr) from 50.0000(Max) to 0.50000(Min)

Sample Data:
Types of Materials to be Processed:GaAs,HgCdTe,Silicon,or other semiconduct
Maximum Number of Sample Processed: 4
Maximum Sample Dimensions (cm) : 2.00000 Height X 2.00000 Width X 25.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.10000(Max) to .1300E-6(Min)

Facility/Hardware Name:AUTOMATED DIRECTIONAL SOLIDIFICATION Abbr:ADSF NASA Code:EN NASA Center:MSFC

Development Status:D Sponsor:NASA

A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:TO INVESTIGATE CONVECTION AND CONVECTION/DIFFUSION TRANSPORT BY PROVIDING DIRECTIONAL SOLIDIFICATION OF EUTECTIC, OFF EUTECTIC, AND PERITECTIC COMPOSITES.

Abstract:FOUR SEPARATE FURNACE HEATING UNITS ARE PRESENT, CONSISTING OF AN INDIVIDUAL HEATER MODULE AND COPPER QUENCH BLOCK. EACH HEATING UNIT IS TRANSLATED ALONG THE AXIS OF THE SMAPLE DURING THE MELT PROCESS. COOLING IS ACCOMPLISHED AS THE WATER COOLED COPPER QUENCH BLOCK IS TRANSLATED ALONG THE SAMPLE AXIS. THE DRIVE SYSTEM IS VARIABLE SPEED WITH MICROPROCESSOR CONTROL OF THE TRANSLATION SPEED AND ANY REQUIRED RATE CHANGE. ATMOSHPHERIC AND ENVIRONMENTAL CONTROL ARE MAINTAINED BY THE SEALED FURNACE ENCLOSURE.THE PROCESS ALLOWS INVESTIGATION INTO THE ANISOTROPIC PROPERTIES OF METALS AND THE UNUSUAL ELECTRICAL, MAGNETIC, AND OPTICAL PROPERTIES OF UNIQUE DIRECTIONALLY SOLIDIFIED MOLECULAR STRUCTURES.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1600.00(Max) to -0- (Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts): 15.0000
Translation rates (if applicable in mm/hr) from 500.000(Max) to 0.10000(Min)

Sample Data:
Types of Materials to be Processed:METAL COMPOSITES
Maximum Number of Sample Processed: 4
Maximum Sample Dimensions (cm) : 0.50000 Height X 0.50000 Width X 13.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:BUBBLE BEHAVIOR UNIT Abbr:BBU NASA Code:na NASA Center:na

Development Status:D Sponsor:JAPANESE SPACE AGENCY
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:THE BBU IS USED TO OBSERVE THE BUBBLE MOTION IN LIQUID UNDER A TEMPERATURE GRADIENT AND STATIONARY ACOUSTIC WAVE.

Abstract:A GROUND BASED TEST UNIT HAS BEEN DEVELOPED. THE BBU IS AT PRESENT IN THE DESIGN PHASE AND IS EXPECTED TO FLY ON SPACE LAB -J IN 1988. The Bubble Behavior in microgravity is an investigation concerning the movement and interaction of air bubbles and fluid drops in silicon oil under a temperature gradient. Also the generation of vibration of air bubbles in silicon oil under acoustic waves will be observed. BBU contains a cell mounting connector, a cell fixture device, optical and lighting system for TV camera, bubble injectors, and sound insulation box.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 100.000(Max) to 22.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts): 310.000
Translation rates (if applicable in mm/hr) from 1.00000(Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:SILICON OIL;AIR
Maximum Number of Sample Processed: 4
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to 1.00000(Min)

Facility/Hardware Name:CHEMICAL VAPORT TRANSPORT   Abbr:CVT   NASA Code-.C   NASA Center:MSFC

Development Status:C   Sponsor:BOEING

A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:CONSISTS OF THREE FURNACES WHICH WIL ALLOW INVESTIGATORS TO PHOTOGRAPH .OWING CRYSTAL

Abstract:EACH SELF-CONTAINED FURNACE WILL BE ENCASED IN STAINLESS STEEL AND HAVE A VIEWPORT WHERE A MICROSCOPE/CAMERA CAN BE INSTALLED FOR OBSERVATIONS. WHILE THE FURNACE CORES REACH OPERATION TEMPERATURES UP TO 900 DEGREES C, AN INVESTIGATOR WILL BE ABLE TO WATCH THE CRYSTAL NUCLEATION AND GROWTH OF SIX SAMPLES SEALED IN FUSED SILCIA AMPOULES. THE OPERATOR ALSO WILL BE ABLE TO REMOTELY POSITION THE AMPOULES IN THE INTERIOR THERMAL FIELD OF THE FURNACES TO OPTIMIZE CRYSTAL GROWTH. A PROTOTYPE OF THIS APPARATUS IS BEING TESTED.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1100.00(Max) to 600.000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:-0-
Maximum Number of Sample Processed: 2
Maximum Sample Dimensions (cm) : 2.00000 Height X 2.00000 Width X 8.00000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:CONTINUOUS FLOW ELECTROPHORESIS SYSTEM Abbr:CFES NASA Code:IC NASA Center:MSFC

Development Status:D Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

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Purpose:TO PERMIT EXPLORATORY SEPARATION OF BIOLOGICAL MATERIALS WITHOUT THE INFLUENCES OF THERMAL CONVECTION CELLS IN THE SEPARATION COLUMN.

Abstract:THE CELL HANDLING FACILITIES ALLOW THE SEPARATION OF LIVING CELLS AS WELL AS MACROMOLECULES. A LARGE CROSS SECTION CHAMBER PERMITS A HIGH CONTINUOUS RATE OF FLOW, CONSEQUENTLY INCREASING THE POTENTIAL PROCESS VOLUME OF THE SAMPLE MATERIAL. SAMPLE TEMPERATURE CAN BE MAINTAINED FOR SEVERAL HOURS, PERMITTING THE RECOVERY OF LIVING CELLS. THE SAMPLE IS INJECTED INTO THE ELECTROPHORESIS CHAMBER AND CARRIED INTO AN ELECTRIC FIELD BY THE BUFFER. UNDER THE INFLUENCE OF THE FIELD, IN MICROGRAVITY, THE VARIOUS SUBFRACTIONS OF THE SAMPLE ARE DEFLECTED ACCORDING TO THEIR RESPECTIVE MOBILITIES AND ENTER A CHANNEL COLLECTOR AT THE END OF THE CHAMBER. IDEALLY EACH FRACTION SEGREGATES INTO A DIFFERENT CHANNEL WHERE IT IS THEN MOVED THROUGH TUBING BY A PERISTALTIC PUMP TO COLLECTION BAGS IN A THERMALLY CONTROLLED CHAMBER.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 25.0000(Max) to 10.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts): 680.000
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:LIVING CELLS AND MACROMOLECULES
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 20.0000 Height X 10.0000 Width X 10.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:CONTINUOUS HEATING FURNANCE Abbr:CHF NASA Code:na NASA Center:na

Development Status:A Sponsor:JAPANESE SPACE AGENCY

A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:USED TO PERFORM HIGH TEMPERATURE HEAT TREATMENT OF SOLIDS. DESIGNED AS A VACU-UM FURNANCE TO PROCESS SAMPLES CONTINUOUSLY. HEATING AND COOLING IS CONDUCTED IN PARALLEL.

Abstract:THE CHF CONSISTS OF TWO VACUUM-HEATING CHAMBERS AND TWO He-GAS COOLING CHAMBERS TO SIMULTANEOUSLY PROCESS FOUR SAMPLE CARTRIDGES UNDER PROGRAMMED TEMPERATURE PROFILES. TWO SAMPLES ARE THUS HEATED WHILE THE OTHER TWO ARE COOLED. CHF SUPPORTS THE FOLLOWING EXPERIMENTS: CASTING OF SUPERCONDUCTING FILAMENTARY COMPOSITE MATERIALS, DIFFUSION IN LIQUID STATE AND SOLIDIFICATION OF BINARY SYSTEM, FABRICATION OF VERY-LOW-DENSITY, HIGH-STIFFNESS CARBON FIBER/Al HYBRIDIZED COMPOSITES, FABRICATION OF Si-As-Te: Ni TERNARY AMORPHOUS SEMICONDUCTOR IN THE MICROGRAVITY ENVIRONMENT IN SPACE, AND SOLIDIFICATION OF EUTECTIC SYUSTEM ALLOYS IN SPACE.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1300.00(Max) to 700.000(Min) with a Maximum Temperature Delta of 5.00000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Al-Pb-Bi, Au-Al, Au-Ag, Si-As-Te, Al-Cu
Maximum Number of Sample Processed: 4
Maximum Sample Dimensions (cm) : 1.30000 Height X 1.30000 Width X 5.40000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:CRITICAL FLUID LIGHT SCATTERING EXP. Abbr:CFLSE NASA Code:EN NASA Center:JPL

Development Status:C Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:MEASURE THE DECAY RATES OF CRITICAL DENSITY FLUCTUATIONS IN A SIMPLE FLUID (XENON) VERY NEAR ITS LIQUID-VAPOR CRITICAL POINT.

Abstract:LASER LIGHT SCATTERING AND PHOTON CORRELATION SPECTROSCOPY WILL BE USED. SUCH EXPERIMENTS HAVE BEEN SEVERELY LIMITED ON EARTH BY THE PRESENCE OF GRAVITY, WHICH CAUSES LARGE DENSITY GRADIENTS IN THE SAMPLE WHEN THE COMPRESSIBILITY DIVERGES AS THE SAMPLE APPROACHES THE CRITICAL POINT. IF THIS TECHNIQUE CAN BE USED IN MICROGRAVITY, VALUABLE DATA ON THE FUNDAMENTAL PHYSICS OF OTHER FLUIDS CAN BE COLLECTED.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 16.0000(Max) to 0.00000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:XENON
Maximum Number of Sample Processed:-0-
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 5.00000(Max) to 0.00000(Min)

Facility/Hardware Name:DIFFUSIVE MIXING OF ORGANIC SOLUTIONS Abbr:DMOS NASA Code:IC NASA Center:MSFC

Development Status:D Sponsor:NASA & 3M
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:TO PROVIDE A FLIGHT APPARATUS FOR STUDIES OF DIFFUSION-LIMITED CRYSTAL GROWTH AND MOLECULAR CRYSTAL STRUCTURES.

Abstract:THE DMOS-2 CONFIGURATION CONSISTS OF SIX CHEMICAL REACTORS HOUSED IN AN EAC. EACH REACTOR, OR CELL, CONTAINS 3 SEPARATE CHAMBERS WHICH HOLD ORGANIC LIQUIDS TO BE MIXED. VALVES BETWEEN THE CELL CHAMBERS ARE OPENED TO ALLOW THE LIQUIDS TO MIX. IN TWO OF THE SIX DMOS CELLS, FLUID MIXING PHENOMENA WILL BE STUDIED. EXPERIMENTS IN ONE CELL WILL INVESTIGATE THE MIXING OF TWO LIQUIDS OF SMALL DENSITY VARIATION. THE OTHER FOUR CELLS WILL BE USED TO EXAMINE MOLECULAR CRYSTAL STRUCTURE. THE PURPOSE OF EXPERIMENTS IN TWO OF THESE CELLS IS TO EXAMINE HOW MOLECULES WITHIN A CRYSTAL ARE ORDERED DURING THE GROWTH PROCESS. THE REMAINING TWO CELLS WILL INVESTIGATE HOW CRYSTALS PACK TOGETHER, AND CRYSTALS GROWN IN CENTRAL CHAMBERS OF THESE CELLS WILL BE ANALYZED FOR THEIR ELECTRO-OPTICAL PROPERTIES.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 500.000(Max) to 20.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 0.00000
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:ORGANICS
Maximum Number of Sample Processed: 6
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 5.00000(Max) to 1.00000(Min)

Facility/Hardware Name:DIRECTIONAL SOLIDIFICATION FURNACE Abbr:DSF NASA Code:IC NASA Center:LeRC

Development Status:B Sponsor:NASA (GRUMMAN)
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:TO DETERMINE THE FEASIBILITY OF GROWING ULTRA-HIGH QUALITY GALLIUM ARSENDIE CRYSTALS IN SPACE, LEADING TO THE PRODUCTION OF GALLIUM ARSENIDE IN SPACE.

Abstract:THE FURNACE WILL BE THE BRIDGMAN TYPE, WHEREIN THE FURNACE CONTAINING A PRECISE TEMPERATURE GRADIENT MOVES OVER A STATIONARY QUARTZ AMPOULE CONTAINING GALLIUM ARSENIDE, MELTING IT AT 1340 C AND SOLIDIFYING IT INTO A SINGLE CRYSTAL ROD OR INGOT. THE ROD OR INGOT IS LATER SLICED INTO WAFERS WHICH ARE USED AS THE BASE MATERIAL FOR IMPLANTING SEMICONDUCTOR DEVICES IN MICROWAVE RADAR, SUPER COMPUTERS,RADIATION HARD SIGNAL PROCESSORS, AND ELECTRO-OPTICAL COUPLERS. TWO PROTOTYPES FURNACES HAVE BEEN FABRICATED AND ARE BEING TESTED.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1240.00(Max) to -0- (Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:GALLIUM ARSENDIDE, CADMIUM TELLURIDE
Maximum Number of Sample Processed:-0-
Maximum Sample Dimensions (cm) : 3.00000 Height X 3.00000 Width X 60.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:DROP DYNAMICS MODULE Abbr:DDM NASA Code:EN NASA Center:JPL

Development Status:D Sponsor:NASA

A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:TO TEST THEORETICAL PREDICTIONS OF DROP BEHAVIOR IN AN ENVIRONMENT IN WHICH SURFACE TENSION IS THE DOMINANT FORCE.

Abstract:THE DDM USES SOUND WAVES IN A RESONANCE CHAMBER TO POSITION AND MANIPULATE LIQUID DROPS AT ROOM TEMPERATURE IN A MICROGRAVITY ENVIRONMENT. THE ACOUSTIC FORCES POSITION THE SAMPLE IN THE CENTER OF THE CHAMBER SO THAT IT WILL STAY IN ONE LOCATION, ALLOWING CLOSE-UP PHOTOGRAPHY. SOUND IS ALSO USED TO MANIPULATE THE SAMPLE BY APPLYING A FORCE MODULATED AT A LOW FREQUENCY, ENERGY CAN BE TRANSFERRED INTO THE DROP. THE ACOUSTIC FIELD CAN ALSO PRODUCE A TORQUE UPON THE DROP. THE OPERATOR VARIES THE ACOUSTIC SIGNALS TO PERFORM THE DESIRED EXPERIMENT WHILE OBSERVING THE RESPONSE OF THE LIQUID SAMPLE. THE EXPERIMENT MAY ALSO BE RECORDED ON VIDEOTAPE FOR DOWNLINKING TO THE GROUND SUPPORT TEAM FOR NEAR-REAL TIME ANALYSIS OR ON 16mm FILM FOR POSTFLIGHT ANALYSIS.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 20.0000(Max) to 20.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 0.00000
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:WATER-GULCERINE MIXTURE, SILICONE OIL
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0-· (Min)

Facility/Hardware Name:DROPLET COMBUSTION EXPERIMENT Abbr:DCE NASA Code:EN NASA Center:LeRC

Development Status:C Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:A BETTER UNDERSTANDING OF THE SUBTLE PROCESSES OCURRING DURING COMBUSTION WILL LEAD TO IMPROVEMENTS IN THE COMBUSTION SYSTEMS OF CARS, POWER PLANTS, AND OTHER MECHANISMS.

Abstract:THE DCE WILL BE USED FOR COMBUSIION EXPERIMENTS WITH DROPLETS AND SMALL SAMPLES OF OTHER MATERIALS SUCH AS PAPER AND PLASTICS. DROPLETS WILL BE SUSPENDED AND IGNITED IN THE DCE CHAMBER. PRESSURE AND TEMPERATURE SENSORS WILL MONITOR THE ENVIRONMENT, AND A FILM SYSTEM WILL RECORD TWO VIEWS OF THE BURNING DROPLET.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 20.0000(Max) to 20.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 250.000
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:LIQUID FUELS
Maximum Number of Sample Processed: 100
Maximum Sample Dimensions (cm) : 0.10000 Height X 0.10000 Width X 0.10000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 10.0000(Max) to 1.00000(Min)

Facility/Hardware Name:DROPLET TECHNOLOGY DEMONSTRATION Abbr:DTD NASA Code:EN NASA Center:LeRC

Development Status:D Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:COMBUSTION OF SINGLE MILLIMETER SIZED DROPLETS IN A SEALED CONTAINER FILLED WITH AIR OR PRESELECTED OXYGEN ENRICHED ATMOSPHERE.

Abstract:The Droplet Technology Demonstration (DTD) facility burns liquid fuels in low acceleration environment to determine the effects of diffusion on the combustion process. This experiment will suspend a liquid fuel droplet, ignight it and record (on film) the flame pattern. From this data correlation bettween experimental results and experimenters calculations.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 20.0000(Max) to 20.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 250.000
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:Liquid fuels
Maximum Number of Sample Processed: 25
Maximum Sample Dimensions (cm) : 0.10000 Height X 0.10000 Width X 0.10000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 10.0000(Max) to 1.00000(Min)

Facility/Hardware Name:Electrodeposition Abbr:EDEP NASA Code:Code C NASA Center:MSFC

Development Status:D
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:University of Alabama in Huntsville-CCDS

Purpose:The apparatus will consist of 80 to 100 electrodeposition cells. The purpose is to study electrodeposition of metal ions, codep. of metal cermets, and electrodep. of crystaline mat

Abstract:The goal of electrodeposition is to establish a space based production process to develop commercially valuable product of superior quality to those produced by ground based processes. Electrodeposition in low gravity can be used to develop and produce commercially valuable products such as metal catalysts and bearing surfaces. Improved catalysts can increase the output of catalytic processes and improved bearing surfaces can lengthen the life mechanical equipment. The heart of the electrodeposition aparatus will consist of 80 to 100 electrodeposition cells. The majority of the cells would be dedicated to electrodeposition of positive metal ions from liquid solution. Several cells would be utilized for codeposition of dense hard neutral particles (cermets) with metal materials of nickel and cobalt.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 25.0000(Max) to -0- (Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Metal ions and metal cermets in solution
Maximum Number of Sample Processed: 100
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:Electroepitaxial Crystal Growth Abbr:ECG NASA Code:IC NASA Center:MSFC

Development Status:A Sponsor:MRA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To grow GaAs and other electronic and electo-optical crystal in the furnace. The furnace will use the liquid phase electroepitaxy crystal growth method.

Abstract:The ECG is being built by Microgravity research Associates, Inc. under a Joint Endeavor Agreement (JEA) with NASA. The furncae will be used to grow Gallium Arsenide and other electronic and electro-optical crystals in the furnace. The furnace will use the liquid phase electroepitaxy crystal growth method which grows crystals at lower temperatures than melt growth methods. This technique has been used in the laboratory to yeild bulk gallium arsenide crystals of higher quality than crystals grown with other techniques. The furncace also will be capable of producing other compounds of commercial and military importance.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1000.00(Max) to 22.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rate (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:GaAs
Maximum Number of Sample Processed: 6
Maximum Sample Dimensions (cm) : 10.1600 Height X 10.1600 Width X 17.7800 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 2.00000(Max) to 1.00000(Min)

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Facility/Hardware Name:ELECTROMAGNETIC LEVITATOR Abbr:EML NASA Code:EN NASA Center:MSFC

Development Status:D Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:FOR PERFORMING UNDERCOOLING AND NUCLEATION STUDIES, PREPARATION OF AMORPHOUS AND METASTABLE PHASES IN METALLIC SYSTEMS, AND THERMOPHYSICAL MEASUREMENTS

Abstract:THE EML ALLOWS A CONDUCTIVE SAMPLE TO BE POSITIONED IN THE LEVITATION COIL AND MELTED BY INDUCTIVE HEATING IN A VACUUM OR CONTROLLED GASEOUS ENVIRONMENT. FOLLOWING THE MELT PHASE, POWER MAY BE REDUCED AT A RAPID RATE, ALLOWING RADIATIVE COOLING AND SOLIDIFICATION OF THE SPECIMEN. ADDITIONAL COOLING IS POSSIBLE THROUGH THE USE OF A QUENCH GAS. PYROMETRIC OBSERVATION OF THE SPECIMEN SURFACE, WITHOUT INTERFERENCE FORM A CONTAINER WALL, CAN ALSO BE ACCOMPLISHED. THE SAMPLE IS SUSPENDED IN THE ELECTROMAGNETIC FIELD OF A CUSP COIL AND IS HEATED AND MELTED BY INDUCTION FROM THE COIL'S ELECTROMAGNETIC FIELD. AN ACTIVE SERVO POSITIONING SYSTEM MAINTAINS THE ELECTRICALLY CONDUCTIVE SPECIMEN IN THE CENTER OF THE COIL SYSTEM AGAINST ACCELERATION DURING FLIGHT AND DAMPS OSCILLATIONS OF THE SPECIMEN.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1300.00(Max) to -0- (Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:-0-
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

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Facility/Hardware Name:ELECTROPHORESIS OPERATIONS IN SPACE Abbr:EOS NASA Code:IC NASA Center:MSFC

Development Status:D Sponsor:NASA

A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:TO PROVIDE AN APPARATUS FOR SPACE-BASED RESEARCH IN THE ELECTROPHORETIC SEPARATION OF BIOLOGICAL MATERIALS

Abstract:SCIENTIFIC ADVANCES IN THE AREA OF PHARMACEUTICAL MATERIALS PROCESSING IN SPACE MAY PERMIT NEW TREATMENTS FOR A NUMBER OF DISEASES. IN CONTINUOUS FLOW ELECTROPHORESIS, BIOLOGICAL MATERIALS ARE SEPARATED WHEN SUBJECTED TO AN ELECTRICAL FIELD. HOWEVER, EARTH'S GRAVITY LIMITS THE QUANTITY AND PURITY OF THE PRODUCT. CURRENTLY, EOS CAN SEPARATE MORE THAN 700 TIMES THE AMOUNT OF MATERIAL AT A 4-TIMES GREATER PURITY THAN CAN SIMILAR OPERATIONS ON EARTH. AN ORGANIC SAMPLE, OR SOURCE MATERIAL, IS INTRODUCED INTO A LONG, NARROW CHAMBER IN WHICH AN ELECTRICAL FIELD SEPARATES THE DIFFERENT BIOLOGICAL MATERIALS ACCORDING TO THEIR MOBILITIES. EACH SEPARATED FRACTION IS THEN COLLECTED AND RETURNED TO EARTH.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 25.0000(Max) to 10.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts): 3500.00
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Biomaterials, cells protiens
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:FLOAT ZONE CRYSTAL GROWTH FACILITY Abbr:FZCGF NASA Code: NASA Center:MSFC

Development Status:A Sponsor:
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:PRODUCE HIGH QUALITY, DISLOCATION-FREE CRYSTALS OF ELEMENTAL OR LIGHTLY DOPED MATERIALS SUCH AS SILICON A... OTHER CANDIDATE SEMICONDUCTORS.

Abstract:THE FACILITY SHALL HAVE THE FUTURE CAPABILITY TO SERVICE FLOAT ZONE CRYSTAL GROWTH, FLOAT ZONE PURIFICATION OF MATERIALS, DIRECTIONAL SOLIDIFICATION, AND CRYSTALLIZATION PHENOMENA. THE INITIAL ON-ORBIT FACILITY WILL PROVIDE RESULTS THAT MAY BE UTILIZED FOR THE PROCESSING OF RESEARCH AND COMMERCIAL SCALE SAMPLES(UP TO 10 cm IN DIAMETER). THE FACILITY WILL CONSIST OF A MODULAR FURNACE, A SAMPLE ROTATION MECHANISM, SUPPORT ELECTRONICS, VIDEO CAPABILITY (DURING PROCESSING PHASE), AND A DATA COLLECTION SYSTEM.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 2200.00(Max) to 400.000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from 50.0000(Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:INORGANIC SEMICONDUCTORS,METALS,ALLOYS
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 0.00000 Height X 0.00000 Width X 41.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:FLUIDS EXPERIMENT APPARATUS Abbr:FEA NASA Code:IC NASA Center:MSFC

Development Status:D Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:TO PROVIDE A CONVENIENT, LOW COST,MODULAR, MICROGRAVITY BIOLOGY/CHEMISTRY/PHYSICS EXPERIMENT SYSTEM TO INDUSTRIAL USERS TO SUPPORT FUNDAMENTAL SPACE PROCESSSING RESEARCH.

Abstract:THE FEA IS DESIGNED TO CONDUCT BASIC AND APPLIED PROCESS OR PRODUCT DEVELOPMENT EXPERIMENTS IN GENERAL LIQUID CHEMISTRY,CYRYSTAL GROWTH, FLUID MECHANICS, THERMODYNAMICS, AND THE CELL CULTURING OF BIOLOGICAL MATERIALS AND LIVING ORGANISMS. THE CURRENT CONFIGURATION WILL ACCOMMODATE FLOAT ZONE CRYSTAL GROWTH AND CERTAIN FLUID HANDLING EXPERIMENTS. FEA HAS THE CAPABILITY TO MANIPULATE GASEOUS, LIQUID ,OR SOLID SAMPLES, TO EXPOSE SAMPLES TO VACUUM CONDITIONS, AND TO HEAT AND COOL SAMPLES. A NUMBER OF SPECIALIZED SUBSYSTEMS ARE PLANNED FOR THE FEA, INCLUDING LOW-TEMPERATURE AIR HEATERS, LIVING ORGANISM INCUBATORS, HIGH-TEMPERATURE FURNACES, CUSTOM-DESIGNED HEATERS, SPECIAL SAMPLE CONTAINERS, AND A SPECIMENT CENTRIFUGE.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 100.000(Max) to 0.00000(Min) with a Maximum Temperature Delta of 10.0000(deg C)
Maximum Cooling Rate (watts): 50.0000
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:Various inert fluids.
Maximum Number of Sample Processed: 3
Maximum Sample Dimensions (cm) : 1.00000 Height X 1.00000 Width X 3.00000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 0.01000(Min)

Facility/Hardware Name:FLUIDS EXPERIMENT SYSTEM Abbr:FES NASA Code:EN NASA Center:MSFC

Development Status:D Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:TO PROVIDE AN APPARATUS FOR INVESTIGATING THE EFFECTS OF MICROGRAVITY ON SEPARATION OR SOLIDIFICATION PROCESSES IN TRANSPARENT FLUIDS.

Abstract:THE FES CAN ACCOMODATE A VARIETY OF EXPERIMENTAL CELLS FOR PERFORMING A BROAD RANGE OF FLUID EXPERIMENTS IN AREAS SUCH AS FLUID CONVECTION, PHASE TRANSITION, SURFACE PHYSICS, AND BUBBLE BEHAVIOR. A TEST CELL CAN BE PLACED FIRST IN THE FES PREHEAT ENCLOSURE FOR NONCRITICAL EXPERIMENT HEATING, THEN TRANSFERRED MECHANICALLY TO AN OPTICAL BENCH WHERE THE MAJORITY OF EXPERIMENT OPERATIONS TAKE PLACE. THIS ALLOWS ONE SAMPLE TO BE PREHEATED WHILE ANOTHER IS BEING COMPLETED ON THE OPTICAL BENCH. AS THE EXPERIMENT PROGRESSES, REAL-TIME FLOW HOLOGRAMS ARE MADE FOR POSTFLIGHT ANALYSIS, AND AN ACCELEROMETER LOCATED ON THE OPTICAL BENCH CONTINUOUSLY MEASURES THE VIBRATION ENVIRONMENT. THE FES ALSO CONTAINS A WATER LOOP FOR RAPIDLY HEATING OR COOLING THE TEST CELL WHILE IT IS ON THE OPTICAL BENCH.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 120.000(Max) to 20.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts): 0.00000
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:TRIGLYCINE SULFATE
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 3.00000 Height X 3.00000 Width X 4.00000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:GAS-JET DIFFUSION FLAMES EXPERIMENT Abbr:GDFE NASA Code:EN NASA Center:LeRC

Development Status:B Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:STUDIES THE MECHANISMS COMMON TO BOTH UNWANTED FIRES AND CONTROLLED COMBUTION SYSTEMS.

Abstract:RESULTS FROM THESE EXPERIMENTS MAY AID IN THE DESIGN OF FIRE PREVENTION TECHNIQUES AS WELL AS LEAD TO A BETTER UNDERSTANDING OF LAMINAR GAS-JET DIFFUSION FLAMES. ON EARTH, THIS PROCESS IS DIFFICULT TO STUDY BECAUSE OF BUOYANCY EFFECTS INDUCED BY GRAVITY. FOR GDFE, A FLAME IS LIT BY A SPARK IGNITION IN THE CONTROLLED ENVIRONMENT OF AN EXPERIMENT CHAMBER. THE EFFECTS OF DIFFERENT NOZZLE SIZES, GASEOUS FUEL TYPES, FUEL FLOW RATES, CHAMBER PRESSURES, AND OXYGEN CONCENTRATIONS WILL BE EXAMINED.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 50.0000(Max) to 20.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 50.0000
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:Gaseous fuels.
Maximum Number of Sample Processed: 50
Maximum Sample Dimensions (cm) : 10.0000 Height X 10.0000 Width X 10.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 10.0000(Max) to 0.50000(Min)

Facility/Hardware Name:Gradient Furnace for Get-Away-Special Abbr:GFGAS NASA Code:EN NASA Center:LeRC

Development Status:B Sponsor:GTE
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:The purpose of the GFGAS is to directionally solidify gallium arsenide crystals.

Abstract:This low cost furnace will be used to directionally solidify gallium arsenide crystals in a low gravity, quiescent atmosphere. It has been impossible to produce high-quality uniform GaAs crystals on Earth. Experiments in this furnace should help investigators determine how gravity-driven convection contributes to defects observed in these materials and may lead to improved growing techniques on Earth as well as in space.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1200.00(Max) to 200.000(Min) with a Maximum Temperature Delta of 900.000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from 50.0000(Max) to 0.50000(Min)

Sample Data:
Types of Materials to be Processed:Gallium Arsenide
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 8.00000 Height X 1.50000 Width X 1.50000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to .1000E-6(Min)

Facility/Hardware Name:GRADIENT GENERAL PURPOSE ROCKET FURNACE Abbr:G-GPRF NASA Code:EN NASA Center:MSFC

Development Status:D Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:TO PROVIDE THREE CAVITIES FOR MELTING AND RESOLIDIFYING EXPERIMENTAL SPECIMENS IN A MICROGRAVITY ENVIRONMENT WITH NEAR-ISOTHERMAL OR GRADIENT TEMPERATURE PROFILES.

Abstract:THE G-GPRF PROCESSES SAMPLES IN A VACUUM ENVIRONMENT THAT IS CREATED BY VENTING LOW-PRESSURE ARGON GAS TO THE SPACE ENVIRONMENT DURING FLIGHT. EACH OF THE THREE G-GPRF INDEPENDENTLY CONTROLLED CAVITIES CONSISTS OF A THREE-ZONE FURNACE THAT CAN OPERATE IN A GRADIENT MODE. THIS TEMPERATURE GRADIENT IS MAINTAINED BY PROGRAMMABLE CONTROL OF THREE HEATING ELEMENTS AND A HEAT EXCHANGER IN THE CAVITY. SAMPLES ARE COOLED AT SPECIFIED RATES EITHER BY A HELIUM GAS QUENCH THROUGH A COMMON MANIFOLD OR BY A WATER-COOLED HEAT SINK ASSOCIATED WITH EACH CAVITY.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 100.000(Max) to 100.000(Min) with a Maximum Temperature Delta of 100.000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:-0-
Maximum Number of Sample Processed: 3
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:GRADIENT HEATING FURNANCE Abbr:GHF NASA Code:na NASA Center:na

Development Status:A Sponsor:JAPANESE SPACE AGENCY
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:GHF ALLOWS ACCURATE TEMPERATURE CONTROL OF UNIDIRECTIONAL SOLIDIFICATION AND CRYSTAL GROWTH OF SEMICONDUCTORS, CERAMICS AND ALLOYS. ITS HELIUM GAS IS USED FRO RAPID COOLING.

Abstract:THE GHF IS A TRAVELING HEATER-TYPE, VACUUM-HEATING FURNACE WITH THREE HEATING ZONES OF HIGH, GRADIENT AND LOW TEMPERATURES. A CARTRIDGE IS INSTALLED INTO THE GHF, THEN THE HEATING BLOCK MOVES ALONG ITS SAMPLE PORTION DURING THE EXPERIMENT ACCORDING TO THE PROGRAMMED TEMEPRATURE PROFILE. AN ULTRASONIC HOMOGENIZER CAN BE ATTACHED TO THE CARTRIDGE. THE GHF SUPPORTS THE FOLLOWING EXPERIMENTS: GROWTH EXPERIMENT OF NARROW BAND-GAP SEMICONDUCTOR OF PbSnTe SINGLE CRYSTALS IN SPACE, STUDY ON SOLIDIFICATION OF IMMISCIBLE ALLOYS, CRYSTAL GROWTH OF COMPOUND SEMICONDUCTORS IN A LOW-GRAVITY ENVIRONMENT.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1200.00(Max) to 600.000(Min) with a Maximum Temperature Delta of 5.00000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from 54.0000(Max) to 1.00000(Min)

Sample Data:
Types of Materials to be Processed:PbSnTe, Al-In, AlPbBi, CuPb, GaAs
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 2.40000 Height X 2.40000 Width X 11.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to .1300E-5(Min)

Facility/Hardware Name:HIGH TEMPERATURE ACOUSTIC LEVITATOR Abbr:HAL NASA Code:EN NASA Center:MSFC

Development Status:B Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:TO INCREASE THROUGH CONTAINERLESS PROCESSING THE PURITY OF GLASSES, CERAMICS, OR OTHER MATERIALS REQUIRING VERY HIGH PROCESSING TEMPERATURES.

Abstract:THE HAL IS A SECOND GENERATION APPARATUS THAT BUILDS ON EXPERIENCE WITH THE SINGLE AXIS ACOUSTIC LEVITATOR (SAAL), AN INSTRUMENT THAT WAS USED TO ACOUSTICALLY LEVITATE, MELT (AT TEMPERATURES UP TO 1500 C), AND RESOLIDIFY GLASS SAMPLES IN SPACE FOR THE FIRST TIME. ON EARTH, IT IS IMPOSSIBLE TO ACOUSTICALLY LEVITATE AND MELT SAMPLES AT TEMPERATURES THIS HIGH. LIKE THE SAAL, THE HAL WILL BE USED TO ACOUSTICALLY LEVITATE AND PROCESS METALS, ALLOYS, CERAMICS, AND GLASSES IN SPACE; HOWEVER, THE HAL WILL ALLOW PROCESSING AT EVEN HIGHER TEMPERATURES (UP TO 2200 C), WILL ALLOW MORE PRECISE POSITIONING AND ROTATION CONTROL, WILL BE OPERATED MANUALLY OR AUTOMATICALLY, WILL BE RECONFIGURED DURING FLIGHT, AND WILL ACCOMMODATE MORE INVESTIGATIONS PER FLIGHT.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 2200.00(Max) to -0- (Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:ceramics, refractory alloys
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 1.00000 Height X 1.00000 Width X 1.00000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:Image Furnace Abbr:IMF NASA Code:na NASA Center:na

Development Status:D
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:Japanese Space Agency

Purpose:The IMF creates a floating zone of sample materials at the focus of two halogen lamp lights condensed by two elliptical mirrors. The IMF can pull or twist the floating zone.

Abstract:The IMF consists of double mirrors, halogen lamps, a silica tube, and a driving mechanism. Seed crystal material is loaded into the lower chamber and raw material into the upper chamber then both materials are fused together using the control panel. Four motor control systems are installed for moving mirrors, upper shaft and lower shaft. A groung based test unit has been developed. The IMF is at present in the preliminary design phase and is expected to fly on the Spacelab-J mission. The unit is compatible with a standard rack configuration. Some examples of the types of crystals that may be grown using this apparatus include Pb-Sn-Te, In-Sb, oxide glass, and samarskite. Contact: Yuichi Yamaura (205/544-5436).

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 2000.00(Max) to 25.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from 200.000(Max) to 2.00000(Min)

Sample Data:
Types of Materials to be Processed:Pb-Sn-Te, In-Sb, oxide glass, samarskite
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 2.00000 Height X 2.00000 Width X 15.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to .1000E-7(Min)

Facility/Hardware Name:INITIAL BLOOD STORAGE EXPERIMENT Abbr:IBSE NASA Code:EN NASA Center:JSC

Development Status:D Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:TO INVESTIGATE FACTORS THAT LIMIT THE STORAGE OF HUMAN BLOOD IN SPACE. COMPARES BLOOD COMPONENTS STORED IN ORBIT WITH BLOOD STORED ON EARTH.

Abstract:BECAUSE THE EFFECTS OF GRAVITY-RELATED FACTOR SUCH AS SEDIMENTATION AND BUOYANCYARE MINIMIZED IN MICROGRAVITY, THE IBSE CAN BE USED TO STUDY ALTERATIONS IN SIZE, SHAPE, METABOLISM, PHYSIOLOGY, AND IMMUNOLOGIC FUNCTION OF CELLS STORED IN ORBIT. THE IBSE MODULE, CONSISTING OF TWO DEWARS WITH STORAGE RACKS AND AN ELECTRONIC CONTROL BOX, IS PARTIALLY DISASSEMBLED, AND BLOOD BAGS ARE PLACED ON THE STORAGE RACKS. THE RACKS ARE REINSERTED INTO THE DEWAR, AND THE DEWAR LIDS ARE BOLTED INTO PLACE. THE MODULE IS THEN PLACED INSIDE A MIDDECK LOCKER, USING PYRELL FOAM TO ISOLATE MECHANICALY THE IBSE HARDWARE FROM THE SIDES OF THE LOCKER. POWER(28Vdc) APPLIED THROUGH AN ELECTRICAL CONNECTOR ON A FRONT PANEL OF SPECIFIED TEMPERATURE LEVEL AND AIR EXCHANGE RATE IN EACH DEWAR. THE LOCKER CAN BE TRANSPORTED TO THE ORBITOR 12 HOURS BEFORE LAUNCH

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 22.0000(Max) to 5.00000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 125.000
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:BLOOD (WHOLE, LEUKOCYTES, PLATELETS)
Maximum Number of Sample Processed: 16
Maximum Sample Dimensions (cm) : 5.08000 Height X 0.64000 Width X 0.64000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:Isoelectric Focusing Abbr:IEF NASA Code:EN NASA Center:MSFC

Development Status:D

A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:NASA Sponsored PI's

Purpose:A device for seperation/purification of biological materials. This facility was developed to help determine the best design of a purification system.

Abstract:By Minimizing density-dependent convection in microgravity, the IEF permits nonturbulent flow of the biological materials to be separated. To produce a pH gradient in the ampholyte buffer and focus the particles to be separated, power of 70 Vdc is simultaneously applied across (end to end) each of eight columns in the IEF apparatus.Movement of colored samples to their isoelectric points (the points at which the pH of the sample and the pH of the buffer are the same) is recorded photographically. Focused sample separations are harvested. The high level of purity of materials from previous flights has proven the effectiveness of the IEF apparatus. In its first use, the apparatus columns had different combinations of three kinds of partitions, two kinds of buffers and one kind of coating to minimize electroosmosis.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 25.0000(Max) to 10.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 30.0000
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Biological materials, ie cells,proteins
Maximum Number of Sample Processed: 8
Maximum Sample Dimensions (cm) : 0.00640 Height X 0.00640 Width X 0.05080 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:Isothermal Dendritic Growth Experment Abbr:IDGE NASA Code:EN NASA Center:LeRC

Development Status:C Sponsor:NASA Sponsored PI's

A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:An isothermal growth chamber to study dendritic growth of organic study fluids in microgravity. The dendrites will be grown, photographed, and studied in this facility.

Abstract:The IDGE will enable investigators to study dendritic growth, a tree-branched-shaped crystallization, in organic materials that model pure metals and metal alloy systems. In microgravity, fluid motion should be reduced and heat transfer should play a more dominate role in crystallization; therefore, investigators should be able to study the role of heat transfer in greater detail. As samples are processed in an isothermal growth chamber, the dendrite crystals will be photographed. Results from these experiments will contribute to advances in metallurgical processing and to the production of metals with enhanced properties.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from -0- (Max) to -0- (Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Model organics with metal/alloy charactr
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:ISOTHERMAL GENERAL PURPOSE ROCKET FURN. Abbr:I-GPRF NASA Code:EN NASA Center:MSFC

Development Status:D Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:TO PROVIDE THREE INDEPENDENT CAVITIES FOR MELTING AND RESOLIDIFYING SAMPLES IN A LOW-G ENVIRONMENT.

Abstract:THE I-GPRF PROCESSES SAMPLES IN A VACUUM ENVIRONMENT THAT IS CREATED BY VENTING LOW PRESSURE ARGON GAS TO THE SPACE ENVIRONMENT DURING FLIGHT. EACH INDEPENDENT CAVITY IN THE I-GPRF HAS A SINGLE HEATER ELEMENT AND IS CONFIGURED TO PROVIDE CONTROLLED HEATUP AND COOLDOWN RATES AND NEAR ISOTHERMAL PROCESSING CONDITIONS FOR EACH SAMPLE. TO ACHIEVE A CONTROLLED SAMPLE COOLDOWN, EACH CAVITY CAN SUPPLY A VARIABLE HELIUM GAS QUENCH THROUGH A MANIFOLD COMMON TO THE OTHER CAVITIES.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 900.000(Max) to 100.000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:METALS AND ALLOYS
Maximum Number of Sample Processed: 3
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:ISOTHERMAL HEATING FURNANCE Abbr:IHF NASA Code:na NASA Center:na

Development Status:D
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:EUROPEAN SPACE AGENCY

Purpose:HEATING CHAMBER IS ISOLATED MULTI-LAYER RESISTANCE FURNANCE WITH LOW HEATING LAG.

Abstract:FURNANCE FACILITY IS DESIGNED TO FIT IN SPACELAB-MATERIAL SCIENCE DOUBLE RACK FACILITY. ON SPACELAB 1, THE IHF HAD TECHNICAL PROBLEMS. IT WAS REPAIRED AND REFLOWN ON SPACELAB D-1.CURRENT STATUS IS UNKNOWN.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1600.00(Max) to 200.000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 110.000
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:-0-
Maximum Number of Sample Processed:-0-
Maximum Sample Dimensions (cm) : 3.00000 Height X 3.00000 Width X 10.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:Lambda Point Experiment   Abbr:LPE   NASA Code:EN   NASA Center:JPL

Development Status:C   Sponsor:NASA Sponsored PI's
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:A liquid helium cryostat with an experiment package to study the superfluid behavior of the liquid at critical temperatures.

Abstract:Large infrared observatories and gyros will use superfluid helium as a coolant; however, to be used effeciently, this unique element must be studied in greater detail. Many subtleties of superfluid helium behaivor are unknown because gravitational effects disturb the unique superfluid state. An instrumented dewer flown on Spacelab 2 mission was used successfully to study bulk fluid dynamics and motion in microgravity. The LPE will use the Spacelab dewer to study superfluid heluim properties at critical temperatures. For the initial experiment, theories will be tested as investigator obesrve the temperature dependence of the heat capacity of helium near the lambda point. High resolution measurements will be made with state-of-the-art thermometry technology.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from -268.000(Max) to -273.000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Liquid Helium
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 0.00000(Min)

Facility/Hardware Name:LARGE ISOTHERMAL FURNANCE Abbr:LIF NASA Code:na NASA Center:na

Development Status:A
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:JAPANESE SPACE AGENCY

Purpose:USED TO HEAT-TREAT LARGE SPECIMENS UNDERUNIFORM TEMPERATURE DISTRIBUTIONS. GAS COOLING IS ALSO AVALIABLE DURING PROCESSING SEQUENCE.

Abstract:THREE-ZONE HEATER CONTAINS THREE THERMO- COUPLES AND ARE CONTROLLED INDEPENDENTLY BY A MICROCOMPUTER. THE LIF SUPPORTS THE FOLLOWING EXPERIMENTS: FORMATION MECHANISM OF DEOXIDATION PRODUCTS IN IRON INGOT DEOXIDIZED WITH TWO OR THREE ELEMENTS, PREPARATION IF Ni BASE DISPERSION STRENGTHENED ALLOYS, STUDY ON THE MECHANISM OF LIQUID PHASE SINTERING. THE UNIT IS DESIGNED TO FIT IN A STANDARD RACK CONFIGURATION.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1600.00(Max) to -0- (Min) with a Maximum Temperature Delta of 9.00000(deg C)
Maximum Cooling Rate (watts): 700.000
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:TUNGSTEN, ALLOYS CONTAING Ni, Mo, Cr, Co
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 2.60000 Height X 2.60000 Width X 16.8000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 10.0000(Max) to -0- (Min)

Facility/Hardware Name:LIQUID DROP EXPERIMENT FACILITY Abbr:LDF NASA Code:na NASA Center:na

Development Status:C Sponsor:JAPANESE SPACE AGENCY
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:THE LDF IS USED TO OBSERVE THE DEFORMATION OF A LIQUID DROP TO STUDY THE STABILITY OF LIQUID MEMBRANEOUS DISKS IN A TRI-AXIAL ACOUSTIC RESONATOR.

Abstract:THE OBJECTIVE OF THE EXPERIMENT IS TO STUDY CONTACTLESS AND STABLE POSITIONING OF LIQUID DROPS, EXCITATION OF CAPILLARY WAVES ON THE LEVITATED LIQUID DROP SURFACE FOR A SPHERICAL AND FOR OBLATE SPHERORIDAL SHAPE AND DEFORMATION OF LIQUID DROPS BY MEANS OF TRI-AXIAL ACOUSTIC RESONANCES. THE STABILITY OF FREE LIQUID MEMBRANEOUS DISKS IS ANOTHER OBJECTIVE IN THE TRI-AXIAL ACOUSTIC RESONANCE FIELDS. THEORIES TO PREDICT A POSSIBLE EXTRACTION OF CAPILLARY WAVES FOR SPHERICAL LIQUID DROPS AND FOR OBLATE SPHEROIDAL ROTATING LIQUID DROPS UNDER THE INFLUENCE OF TRI-AXIAL ACOUSTIC RESONANCES HAVE BEEN DERIVED. THE DEFORMATION OF LIQUID DROP AND THE STABILITY OF LIQUID MEMBRANEOUS DISKS HAVE BEEN ALSO ANALYTICALLY AND EXPERIMENRTALLY INVESTIGATED IN A TRI-AXIAL ACOUSTIC RESONATOR THROUGH EARTH BASED EXPERIMENTS ARE SEVERELY CONSTRAINED.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 20.0000(Max) to 20.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 0.00000
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:SILICON OIL
Maximum Number of Sample Processed: 50
Maximum Sample Dimensions (cm) : 1.00000 Height X 1.00000 Width X 1.00000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:Magnetic Isolation System Abbr:MIS NASA Code:IC NASA Center:

Development Status:C Sponsor:Sperry Corporation
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:A suspension system used to supress accelerations that might disturb the micro gravity environment of materials processing experiments.

Abstract:The MIS is an experiment mounting device designed to reduce accelerations for microgravity materials processing experiments flown aboard the Shuttle. The devices being built by Sperry Corporation under a Joint Endeavor Agreement with NASA. The first model will fly in the orbiter middeck, mounted in the space of one middeck locker. The system uses magnetic suspension techniques to isolate an experiment from vibrations and accelerations induced by pumps, fans, and other such disturbances on the orbiter.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 20.0000(Max) to 20.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 1.00000
Translation rates (if applicable in mm/hr) from 1.00000(Max) to 1.00000(Min)

Sample Data:
Types of Materials to be Processed:TBD
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:MARANGONI CONVECTION UNIT Abbr:MCU NASA Code:na NASA Center:na

Development Status:D
- A = Under Study
- B = In Definition
- C = Being Fabricated
- D = Existing Hardware

Sponsor:JAPANESE SPACE AGENCY

Purpose:THE MCU SYSTEM IS USED TO OBSERVE MARANGONI CONVECTION OF A LIQUID. TWO DIMENSION FLUID FLOW CAN BE OBSERVED AND RECORDED CINEMATOGRAPHICALLY.

Abstract:MCU HEATING BLOCK, COOLING BLOCK, AND GLASS HEATERS EACH CONTAIN A THERMOCOUPLE. A GROUND BASED TEST UNIT HAS BEEN DEVELOPED. THE MCU APPLIES A TEMPERATURE GRADIENT INSIDE THE FREE SURFACE VISCOUS FLUID. THE MCU APPLIES A TEMPERATURE GRADIENT TO A FLUID SURFACE BY COOLING ONE SIDE AND HEATING THE OTHER AND OBSERVING THE MARANGONI CONVECTION ON THE FREE SURFACE.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 50.0000(Max) to 30.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:-0-
Maximum Number of Sample Processed:-0-
Maximum Sample Dimensions (cm) : 2.50000 Height X 2.50000 Width X 2.50000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:Mechanics of Granular Materials Abbr:MGM NASA Code:EN NASA Center:

Development Status:C Sponsor:NASA Sponsored PI's
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To study the load-deformation, stress/strain, inability and failure modes, and ultimate strength of cohesionless grainular materials in dry saturated and partially saturated state.

Abstract:This experiment will use the microgravity environment of the Shuttle to obtain quantitive data on the behavior of cohesionless grandular materials. Data on the behavior of these types of materials are of major scientific and technological importance to a variety of disciplines: soil mechanics and geotechnical engineering, eatrhquake engineering, coastal and off shore engineering, pneumatic transportation, and power technology. The load-deformation,stress-strain, inability and failure modes, and ultimate strength characteristics of cohesionless granular materials (dry, saturated, and partially saturated) at very low confining pressures will be studied. The MGM will consist of a load frame, a motor-driven screw jack, pressure chambers, experiment chambers, various sensors, cameras and a control and data acquisition system.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 25.0000(Max) to 20.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 0.00000
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:sand, soil, gravel,etc.
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 80.0000(Max) to 1.00000(Min)

Facility/Hardware Name:MEPHISTO Abbr:-0- NASA Code:na NASA Center:na-

Development Status:D Sponsor:EUROPEAN SPACE AGENCY
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:THE FURNANCE IS A SPECIALIZED VERSION OFTHE DIRECTIONAL SOLIDIFICATION FURNANCE

Abstract:FURNANCE WILL BE DESIGNED TO BE HOUSED IN AN EXPERIMENT APPARATUS CONTAINER FOR USE ON THE MATERIALS SCIENCE LABORATORY LOCATED IN THE ORBITER PAYLOAD BAY. A GROUND-BASED TEST FURNANCE HAS BEEN DEVELOPED IN FRANCE. PRELIMINARY DESIGN FOR THE FLIGHT FURNANCE IS UNDERWAY AT PRESENT.LEAD TIME FOR COMPLETION OF FLIGHT FURNANCE IS THREE YEARS.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1200.00(Max) to -0- (Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:-0-
Maximum Number of Sample Processed:-0-
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:MIRROR HEATING FURNANCE Abbr:MHF NASA Code:na NASA Center:na

Development Status:D Sponsor:EUROPEAN SPACE AGENCY
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:SAMPLE IS HEATED BY RADIATION FROM TWO HALOGEN LAMPS. LIGHT INTENSITY IS CONTROLLED BY PHOTO CELL. FURNANCE INTERIOR CAN BE EVACUATED OR FILLED WITH ARGON.

Abstract:FURNANCE FACILITY IS DESIGNED TO FIT IN SPACELAB MATERIAL SCIENCE DOUBLE RACK FACILITY. THE MHF HAD TECHNICAL PROBLEMS ON SPACELAB 1. IT WAS REPAIRED AND REFLOWN ON SPACELAB D-1.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 2100.00(Max) to 200.000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:-0-
Maximum Number of Sample Processed:-0-
Maximum Sample Dimensions (cm) : 2.00000 Height X 2.00000 Width X 15.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:Monodisperse Latex Reactor System Abbr:MLRS NASA Code:EN NASA Center:MSFC

Development Status:D
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:NASA Sponsored PI's

Purpose:To produce larger and more uniform monodisperse latex particles than can be manufactured on Earth. The reactor produces 10 to 30 micrometer spheres and other required shapes.

Abstract:THE MLRS CONSISTS OF FOUR MONODISPERSE LATEX REACTORS (MLRs) LOCATED IN AN EXPERIMENT APPARATUS CONTAINER (EAC), A SUPPORT ELECTRONICS PACKAGE (SEP), AND TWO INTERCONNECTING CABLES (ONE FOR POWER, ONE FOR SIGNAL). EACH OF THE MLRs CAN PROCESS UP TO 100 ml OF LATEX-FORMING MATERIAL AT TWO NOMINAL TEMPERATURES (70 OR 90 C) OR AT OTHER TEMPERATURES, IF DESIRED.THE MATERIAL CAN BE STIRRED IN THE PREPROCESS MODE OR STIRRED AND HEATED IN THE PROCESS MODE. DURING THE PROCESS MODE, ONE VOLUME AND FOUR TEMPERATURES (BASE, WALL, PISTON, AND FLUID) ARE MEASURED. THE SEP CONVERTS THE ANALOG DATA TO DIGITAL DATA AND RECORDS THE INFORMATION ONCE EVERY MINUTE.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 90.0000(Max) to 20.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Latex
Maximum Number of Sample Processed: 4
Maximum Sample Dimensions (cm) : 20.5700 Height X 20.5700 Width X 38.1000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:Moving Wall Electrophoresis Unit Abbr:MWEU NASA Code:EN NASA Center:MSFC

Development Status:A Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To evaluate various high resolution cell separation techniques in micrograv . This facili y is to define the follow-on activities for bioprocessing in space.

Abstract:This facility is a modification of the Continuous Flow Electrophoresis System (CFES) concept. It consists of a long, thin rectangular chamber with two opposing electrodes. A buffer (the buffer is an electrolyte) solution containing the desired product flows through the chamber . The facility electrodes generate a field which is perpendicular to the chamber flow. As the electrolyte solution flows through this field the target materials are separated into narrow streams which are collected at the chamber flow exit. Target material location within the flow at the exit is a function of the material's electronic charge. Friction between the flowing buffer solution and the side walls generate forces which inhibit the separation process. Therefore, this facility's walls move with the flow to reduce flow distortion

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Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 25.0000(Max) to 10.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 1000.00
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:biomaterials, cells, proteins, etc.
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:Multiple Experiment Processing Furnace Abbr:MEPF NASA Code:IC NASA Center:MSFC

Development Status:C
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:NASA sponsored PI's

Purpose:A directional solidification furnace with unique quench capability specifically designed for metals and alloy solidification. This facility has on orbit sample change-out as well.

Abstract:THE MEPF WILL BE A MODULAR, SECOND GENERATION VERSION OF EARLIER MODEL DIRECTIONAL SOLIDIFICATION FURNACES. IT WILL PROCESS LARGER SAMPLES THAN EXISTING FURNACES AND PERMIT ON-ORBIT SAMPLE CHANGEOUT. THE FURNACE WILL ACCOMMODATE INVESTIGATIONS OF PHENOMENA INVOLVED IN THE SOLIDIFICATION OF METALS AND SEMICONDUCTOR MATERIALS. EXPERIMENTS IN THIS APPARATUS WILL OPTIMIZE PROCESS PARAMETERS SUCH AS TEMPERATURE GRADIENTS AND STUDY THE EFFECTS PRODUCED BY VARYING THE RELATIVE PERCENTAGES OF MATERIALS SUCH AS DOPANTS. THE MEPF IS BEING DESIGNED FOR AUTOMATIC OR MANUAL OPERATIONS ABOARD SPACELAB OR THE SPACE STATION.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1600.00(Max) to 600.000(Min) with a Maximum Temperature Delta of 400.000(deg C)
Maximum Cooling Rate (watts): 1450.00
Translation rates (if applicable in mm/hr) from 600.000(Max) to 0.06000(Min)

Sample Data:
Types of Materials to be Processed:metals and metal alloys
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 2.20000 Height X 2.20000 Width X 18.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.50000(Max) to 0.00000(Min)

Facility/Hardware Name:Non-Linear Optical Monomers Abbr:NLOM NASA Code:Code C NASA Center:MSFC

Development Status:C
- A = Under Study
- B = In Definition
- C = Being Fabricated
- D = Existing Hardware

Sponsor:University of Alabama in Huntsville-CCDS

Purpose:Non-Linear Optical Monomers will be grown using a fixed array of continuous flow channels. Properly designed organics possess outstanding optical and electrooptical properties.

Abstract:Recent advances in the field of non-linear optics (NLO) hold great promise for important applications in integrated optics, telecommunications, and optical information processing. Potential applications include electarooptical switching, optical amplification for communications, and parallel processing for hybrid optical computers. NLO monomers will be grown using a fixed array of continuous flow channels. These channels will require venting between runs for the inert carrier gases. The temperature distribution ofeach channel will be automatically controlled. The process will be controlled automatically, however, some crew interaction is required for experiment adjustments.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from -0- (Max) to -0- (Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Vapor and liquid phase organic solutions
Maximum Number of Sample Processed:-0-
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:Non-Linear Optical Organic Crystals Abbr:NLOOC NASA Code:Code C NASA Center:MSFC

Development Status:C
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:University of Alabama in Huntsville-CCDS

Purpose:Non-Linear Optical Organic Crystals will be grown using a fixed array of 27 sealed ampoules. The purpose of the experiment is to grow large defect free organic crystals.

Abstract:Recent advances in the field of non-linear optics (NLO) hold great promise for important applications in integrated optics, telecommunications, and optical information processing. Much of the early work in the NLO area focused on inorganic materials. Recent research efforts indicate that properly designed organics could be used for optical and electarooptical switching, optical amplification for communications and parallel processing for hybrid optical computers. Polymeric organic materials have mechanical properties which are superior to the inorganic materials. NLO organic crystals will be grown using a fixed array of 27 sealed ampoules. The temperature distribution of each ampoule will be automatically and individually controlled. A prototype apparatus consists of a 4 in. by .75 in dia. glass tube with a hot and a cold end.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 150.000(Max) to 80.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Organic chemicals sealed in ampoules
Maximum Number of Sample Processed: 27
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:Non-Linear Optical Thin Films   Abbr:NLOTF   NASA Code:Code C   NASA Center:MSFC

Development Status:C   Sponsor:University of Alabama in Huntsville-CCDS

A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:Non-Linear optical thin films will be grown using a fixed array of continuous flow channels. Properly designed organics possess outstanding optical and electrooptical properties.

Abstract:Recent advances in the field of non-linear optics (NLO) hold great promise for important applications in integrated optics, telecommunications, and optical information processing. Potential applications include electrooptical switching, optical amplification for communications, and parallel processing for hybrid optical computers. The temperature distribution of each channel will be automatically controlled. The process will be controlled automatically, however, some crew interaction is required for experiment adjustments. A new apparatus has been designed and constructed for the vapor phase NLO thin film growth experiment. This unit is a prototype of the one which would be flown on the ISF or shuttle. The prototype interior consists of a 4 in. by 0.75 in. dia. glass tube with one cold end and one hot end.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 150.000(Max) to 80.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Vapor and liquid phase organic solutions
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 1.90000 Height X 1.90000 Width X 10.1600 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:Normal Freezing Furnace-1 Abbr:NFF-1 NASA Code:IC NASA Center:MSFC

Development Status:C
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:International Space Corporation

Purpose:This is a commercially developed bridgman type furnace used to produce electronic materials in space.

Abstract:THE NFF IS BEING BUILT BY INTERNATIONAL SPACE CORPORATION AND WILL BE FLOWN ON THE SHUTTLE UNDER A JOINT ENDEAVOR AGREEMENT WITH NASA. THE AUTOMATED FURNACE, WHICH WILL MAKE USE OF DIRECTIONAL SOLIDIFICATION, WILL BE UTILIZED TO PRODUCE A NUMBER OF INFRARED AND SEMICONDUCTOR CRYSTALS. CANDIDATE MATERIALS INCLUDE CADMIUM TELLURIDE AND GALLIUM ARESENIDE. THE GROUND FURNACE DESIGN IS 75 PERCENT COMPLETE AND IS EXPECTED TO BE COMPLETED IN MARCH 1988. THE FIRST FURNACE (NFF-1) IS EXPECTED TO FLY IN JUNE 1989 AND PRODUCE SAMPLES UP TO 2.0 cm IN DIAMETER. THE NFF-2, FIRST FLIGHT IN NOVEMBER OF 1990, WILL PRODUCE SAMPLES UP TO 3 cm IN DIAMETER. NFF-3, FIRST FLIGHT IN MAY OF 1992, WILL PRODUCE UP TO 5 cm SAMPLES, AND THE COMMERCIAL NFF IS EXPECTED TO FLY IN JULY OF 1993 AND WILL PRODUCE SAMPLE FROM 5.0 cm TO 8.0 cm IN DIAMETER.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1600.00(Max) to 400.000(Min) with a Maximum Temperature Delta of 400.000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from 50.0000(Max) to 5.00000(Min)

Sample Data:
Types of Materials to be Processed:CdTe,GaAs,HgCdTe,InP, and others
Maximum Number of Sample Processed: 4
Maximum Sample Dimensions (cm) : 2.50000 Height X 2.50000 Width X 17.5000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.10000(Max) to .1300E-6(Min)

Facility/Hardware Name:Organic & Polymer Crystal Growth Facil. Abbr:OPCGF NASA Code:IC NASA Center:MSFC

Development Status:B Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

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Purpose:To research the influence of microgravity on the structure and characteristics of organic and polymer crystalline materials with unique electrical, magnetic, & optical properties.

Abstract:This apparatus will be dedicated to research on the influence of low-gravity on the structure and characteristics of organic and polymer crystalline materials thet have unique electrical, magnetic and electo-optical properties. In microgravity, where turbulent convection, bouyancy, and sedimentation are reduced, it may be possible to produce new and improved crystals. Requirements for this furnace are bening defined; the goal is to design a modular furnace that can be flown in the Spacelab module and later on the Space Station.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from -0- (Max) to -0- (Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Organic and polymers
Maximum Number of Sample Processed:-0-
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:Organic and Polymer Processing Exper. Abbr:OPPE NASA Code:IC NASA Center:MSFC

Development Status:D Sponsor:3M SR&AL
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:Solution (DMOS), Vapor (PVTOS), and melt growth of organic and polymer crystals by low to moderate temperature processes

Abstract:This facility will house the PVTOS, DMOS and a new directional solidification furncae to support 3M's JEA's on US-1. This DSF will process organics and polymers at much lower temperatures than the AADSF or NNF. Therefore, this is a special furnace TBD.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 200.000(Max) to 20.0000(Min) with a Maximum Temperature Delta of 10.0000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Organics and Polymers
Maximum Number of Sample Processed: 25
Maximum Sample Dimensions (cm) : 2.00000 Height X 2.00000 Width X 10.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:ORGANIC CRYSTAL GROWTH EXP. FACILITY   Abbr:OCF   NASA Code:EN   NASA Center:MSFC

Development Status:C
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:JAPANESE SPACE AGENCY

Purpose:OCF IS USED TO GROW LARGE HIGH QUALITY SINGLE CRYSTALS BY DIFFUSION FROM SOLUTION. VISUAL OBSERVATION OF THE CRYSTAL GROWING IS POSSIBLE.

Abstract:EACH CELL HAS THREE SECTIONS. THE CENTERSECTION IS A PROCESSING CELL, AND THE OTHER TWO SECTIONS CONTAIN DONOR LIQUID AND ACCEPTON LIQUID. A GROUND BASED TESTUNIT HAS BEEN DEVELOPED. THE OCF IS AT PRESENT IN THE PRELIMINARY DEESIGN PHASE AND IS EXPECTED TO FLY ON SPACELAB-J IN 1988. THE UNIT IS COMPATIBLE WITH A STANDARD RACK CONFIGURATION.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from -0-   (Max) to -0-   (Min) with a Maximum Temperature Delta of   0.00000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0-   (Max) to -0-   (Min)

Sample Data:
Types of Materials to be Processed:-0-
Maximum Number of Sample Processed:-0-
Maximum Sample Dimensions (cm) :-0-   Height X-0-   Width X-0-   Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0-   (Max) to -0-   (Min)

Facility/Hardware Name:Organic Separations Abbr:ORSEP NASA Code:Code C NASA Center:MSFC

Development Status:C
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:University of Alabama in Huntsville-CCDS

Purpose:Organic Separations will be accomplished by using sets of separation discs. Each disc unit has small compartments od the solutions and samples. The purpose is to separate org.phase

Abstract:The major interest of this type experiment is to develop the technique of affinity phase partitioning for eventual use in low-g commercial separations. Affinity phase partitioning utilizes an affinity ligand attached to polymers polyethylene glycol(PEG) to pull cells into the PEG-rich phase (unwanted cells remain at the interface between the PEG-rich and dextran-rich phases). This technique has been applied to purifying red blood cells using antibodies to the cells as affinity ligands. The next step is to use this technique to purify large cells such as lymphocytes and megakaryocytes which are important for cancer and immunology research. Phase partitioning of immiscible polymers and various biological materials will be accomplished using sets of separation discs. Each disc has cells which contain the samples.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 25.0000(Max) to 4.00000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Organic Solutions
Maximum Number of Sample Processed:-0-
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:Particle Cloud Combustion Experiment Abbr:PCCE NASA Code:EN NASA Center:LeRC

Development Status:C Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To study the fundamental combustion processes, such as diffusion, which are masked on Earth. The facility will study the flame properties and extinction limits of 2-phase systems.

Abstract:A better understanding of the fundamental combution process will lead to more efficient use of fuels on earth and reduce pollution resulting from combustion. The goal of the PCCE is to study the flame properties and extinction limits for several premixed, quiescent, two-phase combustion systems. The PCCE apparatus will acoustically mix eight separate quantities of fuel particles in transparent flame tubes to obtain quiescent, uniform clouds which will be acoustically energized and ignited.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 40.0000(Max) to 10.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 80.0000
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:Solid or liquid fuels in a cloud.
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 1.00000 Height X 1.00000 Width X 1.00000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 10.0000(Max) to 0.50000(Min)

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Facility/Hardware Name:Phase Partitioning Experiment Abbr:PPE NASA Code:EN NASA Center:MSFC

Development Status:D Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To measure the spontaneous demixing of two-phase systems in microgravity. The PPE has two solutions that are mixed on-orbit and thier separation is observed.

Abstract:The PPE is configured for two methods of phase separation (natural coalescence and surface tension) and to allow variations in interfacial tension, phase volume ratio, phase system composition, and the effect of added particles. The PPE is a Plexiglass apparatus with 24 cavities filled with polymer mixtures of different volume fractions, viscosities, and interface potentials. The experiment apparatus is shaken vigorously and observed photographically for phase separation. Half of the experiments are performed in chambers milled the PPE Plexiglass, the other half in glass cuvettes which fit into Plexiglass containers. On future flights, Plexiglas may be replaced with Lexan or Marguard.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 20.0000(Max) to 20.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from 1.00000(Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Polymer fluids
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 1.40000 Height X 1.40000 Width X 1.40000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to 1.00000(Min)

Facility/Hardware Name:Physical Vapor Transport Of Organic Sol. Abbr:PVTOS NASA Code:IC NASA Center:MSFC

Development Status:D Sponsor:3M

A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To grow organic crystals by vapor transport method.

Abstract:The theoretical and experimental objective of PVTOS are aimed at producing organic thin films with ordered crystalline structures for basic research and commercial product development. PVTOS consists of nine independent experiment cells housed in an EAC. The cells contain three kinds of nontoxic, nonflammable organic materials. Five cells contain a proprietary source material code-named Compund G for studying physical vapor transport, and four cells contain materials for studying film growth, two with copper phthalocyanine and two with dicrboximide. All the materials are large molecules. The experiment is controlled by a microprocessor. Using a hand-held keyboard and display terminal, a crewmember can select and activate the experiment cells, monitor cell temperature and power levels, and perform diagnostic tests.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 500.000(Max) to 20.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Organic Elecetro/optical crystals
Maximum Number of Sample Processed: 9
Maximum Sample Dimensions (cm) : 7.62000 Height X 7.62000 Width X 30.4800 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:Protein Crystal Growth I | Abbr:PCG1 | NASA Code:EN | NASA Center:MSFC

Development Status:D | Sponsor:NASA, UAB

- A = Under Study
- B = In Definition
- C = Being Fabricated
- D = Existing Hardware

Purpose:To explore the use of the microgravity environment of space for crystal growth of proteins of medical and scie. ific interest.

Abstract:The PCG-I is composed of the Vapor Diffusion Apparatus (VDA) and the Dialysis Apparatus (DA). Investigators use vapor diffusion and dialysis techniques to organize biological molecules into large symmetrical crystals. These crystals are then bombarded with X-rays to create diffraction patterns, which are analyzed by computers. Experiments in the VDA take place in closed chambers that are covered with clear plastic windows for visual and photographic monitoring. A droplet of protein solution is extruded onto the tip of a syringe. This drop is suspended over a reservoir of equilibration solution within the chamber. After crystallization is complete, the protein solution and crystals are drawn back in the syringe.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 23.0000(Max) to 18.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Proteins
Maximum Number of Sample Processed: 24
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:Protein Crystal Growth II/III Abbr:PCG2/3 NASA Code:EN NASA Center:MSFC

Development Status:C
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Sponsor:NASA, UAB

Purpose:To explore the use of the microgravity environment of space for crystal growth of proteins of medical and scientific interest.

Abstract:Using data from the previous PCG experiments, a second generation, semi-automatic and thermally controlled PCG facility is being developed for flight in the Shuttle middeck or Spacelab. Vapor diffusion will be used to grow crystals in 120 experimen chambers mounted on trays that slide into a carrier housed in a temperature-controlled Refirgerator/Incubator Module or the LSLE Refrigerator.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 23.0000(Max) to 4.00000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Proteins
Maximum Number of Sample Processed: 24
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:Protein Crystal Growth IV Abbr:PCG4 NASA Code:EN NASA Center:MSFC

Development Status:B Sponsor:NASA, UAB

A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To explore the use of the microgravity environment of space for crystal growth of proteins of medical and scientific interest.

Abstract:This will be a third generation flight apparatus based on two Space Shuttle facilities for protein crystal growth. A spacestation PCG facility will provide for the processing of hundreds of different biological materials in a rang of growth geometries. The facility will be automatically controlled by a microprocessor, and samples will be automatically inserted and retrieved. Crewmembers or investigators on the ground will monitor the growth using a microscope/video system. Before, during, and after processing, crystals will be maintained at an optimum temperature.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 23.0000(Max) to 4.00000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Proteins
Maximum Number of Sample Processed: 48
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:Single Axis Acoustic Levitator Abbr:SAAL NASA Code:EN NASA Center:MSFC

Development Status:D Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To increase, through containerless processing, the purity of glasses, ceramics or other material requireing very high processing temperatures.

Abstract:Eight samples can be processed sequentially and automatically in the SAAL. The samples are stored in a carousel attached to the hot-wall furnace.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 1550.00(Max) to 20.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts): 20.0000
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Ceramics, glasses, others
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 1.00000 Height X 1.00000 Width X 1.00000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:Solid Surface Combustion Experiment Abbr:SSCE NASA Code:EN NASA Center:LeRC

Development Status:C Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To study the burning of solid samples in microgravity to understand the flame spreading and oxygen diffusion of this phenomena.

Abstract:In microgravity, the absence of buoyancy-induced gas-phase flow allows investigators to study other fudamental combustion processes. For the SSCE, thermally thin fuel samples (ashless filter paper) and thermally thick fuel samples (polymethylmethacrylate-PMMA) will be burned in a container chamber in microgravity. Thermocouples and a pressure transducer will monitor flame spreading rates and chamber pressure.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 40.0000(Max) to 10.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 80.0000
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:Ashless filter paper, PMMA, and others
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 2.00000 Height X 0.00100 Width X 4.00000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 10.0000(Max) to 0.50000(Min)

Facility/Hardware Name:Space Ultra-Vacuum Reasearch Facility Abbr:SURF NASA Code:IC NASA Center:MSFC

Development Status:B Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To study molecular beam epitaxy in the ultra-vacuum of a wake sheild.

Abstract:Several US industral concerns are interested in exploring the simultaneous effects of low-gravity and ultra-vacuum on materials processing. Areas of potential interest include molecular beam epitaxy, chemical beam epitaxy, and metal purification. Some of this research is limited on Earth by constraints such as contamination from vacuum chamber walls. After a requirements study, a design concept will be developed using the Shuttle to create an ultra-vacuum wake environment, carry instruments to measure and chacacterize the wake, and support initial experiments that utilize the vacuum environment of the wake. If results from these initial development efforts are promising, the SURF facility will be designed, developed, and tested in space as a free flyer which will be a co-orbiting platform in the vicinity of the Space Station.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from -0- (Max) to -0- (Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:-0-
Maximum Number of Sample Processed:-0-
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

Facility/Hardware Name:Static Column Electrophoretic Separator Abbr:SCES NASA Code:EN NASA Center:MSFC

Development Status:D Sponsor:NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To study the separation of ampholytes by electrophoretic processes in microgravity. The solution of buffer and sample is separated by Ph when a voltage is applied to the solution.

Abstract:Up to eight column assemblies can be operated and photographed in each apparatus. A constant voltage (nominally 70 Vdc) power supply in the apparatus is used to apply potential to each column. The output of the 70 Vdc power supply is 40ma. Once the apparatus is manually turned-on, it operates for 90 minutes and then shuts itself down. During the 90 minutes of operation, 35mm photographs are taken once every three minutes for the first 10 frames, and then once every two minutes for the next thirty frames. This photography sequence can be changed by the time-and control printed circuit board assembly. Columns, voltage displays, temperature readouts, and time are all recorded with the photographs.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 25.0000(Max) to 10.0000(Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts): 32.0000
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Biomaterials, cells, protiens
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 0.47700 Height X 0.47700 Width X 15.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:Surface Tension Driven Convection Exp. Abbr:STDCE NASA Code:EN NASA Center:LeRC

Development Status:C Sponsor:NASA
- A = Under Study
- B = In Definition
- C = Being Fabricated
- D = Existing Hardware

Purpose:To study steady state thermocapillary flows in microgravity.

Abstract:The objective of the STDCE is to design a themocapillary experiment to study the transient and steady state flows in the microgravity envirnoment of space. This data base is needed to develop microgravity facilities in space. Fluid contained in a circular dish will be subjected to an imposed surface heat flux to generate the thermocapillary flow. Quantitative data will be obtained on the nature and extent of the flows, the effects of heating rates on the flows, different thermal sigatures, surface deformations, and flow oscillations.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 50.0000(Max) to 10.0000(Min) with a Maximum Temperature Delta of 0.00000(deg C)
Maximum Cooling Rate (watts): 50.0000
Translation rates (if applicable in mm/hr) from 0.00000(Max) to 0.00000(Min)

Sample Data:
Types of Materials to be Processed:Various fluidssuch as silicon oil.
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 1.00000 Height X 1.00000 Width X 1.00000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00000(Max) to 1.00000(Min)

Facility/Hardware Name:Three Axis Acoustic Levitator Abbr:3AAL NASA Code:EN NASA Center:JPL

Development Status:D Sponsor:NASA

A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To study the effects of three-dimensional acoustic energy on droplet fusion, fission, oscillation, and rotation.

Abstract:Three acoustic drivers positioned along orthogonal axes are used to suspend a droplet in an acoustical energy well. Pulsing or phasing of the drivers permits controlled oscillations or rotations. This allows the droplet to be stirred, generate gas bubbles center the drop, and other positioning.Multiple samples can be injected and controlled while color or B&W motion pictures are obtained, which provide one direct view and two reflected views on othogonal axes. Temperature, acoustic pressure and driver power can be monitored. The apparatus permits the investigation of a variety of fluid dynamic properties and particle interactions.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from -0- (Max) to -0- (Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Low viscosity fluids
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 2.50000 Height X 2.50000 Width X 2.50000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.00100(Max) to 1.00000(Min)

Facility/Hardware Name:Vapor Crystal Growth System Abbr:VCGS NASA Code:EN NASA Center:MSFC

Development Status:D Sponsor:NASA

A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To provide an apperatus in which to grow single crystals in orbit by vapor transport while inhibiting defects.

Abstract:The VCGS furnace contains 3 seperate heating elements: the source heater, the ring heater, and the sting heater. The seed crystal and source material are contained in a sealed ampoule. Source material for the vapor transport process is positioned an the ampoule side wall, while the seed crystal is positioned on a pedestal at the bottom of the ampoule. The source heater warms the ampoule and source material. Growth is controlled by adjusting the temperature of the ring heater, which surrounds the stin and keeps this area warmer than the seed crystal. The sting heater keeps the crystal at cooler temperatures so that the hot vapors from the source material will crystallize on the seed's surface.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from 120.000(Max) to 100.000(Min) with a Maximum Temperature Delta of 80.0000(deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:Electro/optical, semiconductors
Maximum Number of Sample Processed: 1
Maximum Sample Dimensions (cm) : 8.00000 Height X 8.00000 Width X 11.0000 Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from 1.50000(Max) to 0.00000(Min)

Facility/Hardware Name:Zeolite Crystal Growth Abbr:ZCG NASA Code:IC NASA Center:MSFC

Development Status:A Sponsor:Clarkson CCDS/NASA
A = Under Study
B = In Definition
C = Being Fabricated
D = Existing Hardware

Purpose:To study the mixing and growth of zeolites in the microgravity conditions of space.

Abstract:This facility allow the Zeolites to grow from there solutions in a temperature controlled environment. The crystals are limited in size and shape on Earth because of the weight of the crystals is greater than the solution they are grown from and, therefore, they fall out of solution and settle4in the bottom of the chamber. In the microgravity environment of space it is possible to grow larger and defect free crystals.

Summary of Capabilities:

Thermal Data:
Temperatures (deg C) from -0- (Max) to -0- (Min) with a Maximum Temperature Delta of-0- (deg C)
Maximum Cooling Rate (watts):-0-
Translation rates (if applicable in mm/hr) from-0- (Max) to -0- (Min)

Sample Data:
Types of Materials to be Processed:-0-
Maximum Number of Sample Processed:-0-
Maximum Sample Dimensions (cm) :-0- Height X-0- Width X-0- Length (note: if height = width then is Dia.)

Pressure Data:
Operational Pressures (Atm) from -0- (Max) to -0- (Min)

2. EXPERIMENTAL FACILITY DATA

This section contains the resource requirements for each of the individual facilities/experiments in the RACO data base. There are 65 payloads in the data base. Each payload will have a Physical Table, a Power/Thermal Table, a Material Table, a Data Table, and a Functional Flow Timeline. This data base is given in Section 2.1. This section also includes a Summary of User Requirements in Section 2.2. This summary is based on the information given in the Requirements Synopsis Sheets. These sheets summarized the data in the RACO data base. For those requirements for hardware not yet developed, these estimates are based on the best information available at the time of this publication. The results are preliminary and will be refined as the hardware definition develops.

2.1 RACO DATA BASE

This section contains the RACO data base. The 65 facilities covered in the RACO data base are given in Table 2-1. In order to complete the timeline analysis in Section 3.2, it was necessary to reduce the data base to a smaller set that could be completed in a more timely fashion. A set of 16 facilities was selected based on hardware availability, funding level, availability of published data, and desire among the scientific community to conduct similar experimentation. For this set of 16 facilities a Physical Table, a Power/Thermal Table, a Material Table, a Data Table, and a Functional Flow have been completed. The resource requirements for this set were primarily based on the requirements for past experimentation in the case of hardware that has flown. Since many of these requirements were tied to a mission-peculiar shuttle allotment, it should be expected that future experimentation may require more resources with respect to power, data, materials, and venting. In the case of hardware that has not flown, the resource requirements are based on the current design or flight request. The remaining 49 facilities are under study.

TABLE 2.1

PAYLOADS IN RACO DATABASE

Date:03/02/88

No.	Acronym	Item	Phase	Code	Center
1	ACES	ACOUSTIC CONTAINERLESS EXPERIMENT SYS.	D	EN	JPL
2	ALF	Acoustic Levitation Furnace	D	na	na
3	AADSF	Ad. Automated Directional Solidification	C	IC/EN	MSFC
4	ADSF	AUTOMATED DIRECTIONAL SOLIDIFICATION	D	EN	MSFC
5	BBU	BUBBLE BEHAVIOR UNIT	D	na	na
6	CVT	CHEMICAL VAPORT TRANSPORT	C	IC	MSFC
7	CFES	CONTINUOUS FLOW ELECTROPHORESIS SYSTEM	D	IC	MSFC
8	CHF	CONTINUOUS HEATING FURNANCE	A	na	na
9	CFLSE	CRITICAL FLUID LIGHT SCATTERING EXP.	C	EN	JPL
10	DMOS	DIFFUSIVE MIXING OF ORGANIC SOLUTIONS	D	IC	MSFC
11	DSF	DIRECTIONAL SOLIDIFICATION FURNACE	B	IC	LeRC
12	DDM	DROP DYNAMICS MODULE	D	EN	JPL
13	DCE	DROPLET COMBUSTION EXPERIMENT	C	EN	LeRC
14	DTD	DROPLET TECHNOLOGY DEMONSTRATION	D	EN	LeRC
15	EDEP	Electrodeposition	D	Code C	MSFC
16	ECG	Electroepitaxial Crystal Growth	A	IC	MSFC
17	EML	ELECTROMAGNETIC LEVITATOR	D	EN	MSFC
18	EOS	ELECTROPHORESIS OPERATIONS IN SPACE	D	IC	MSFC
19	FZCGF	FLOAT ZONE CRYSTAL GROWTH FACILITY	A		MSFC
20	FEA	FLUIDS EXPERIMENT APPARATUS	D	IC	MSFC
21	FES	FLUIDS EXPERIMENT SYSTEM	D	EN	MSFC
22	GDFE	GAS-JET DIFFUSION FLAMES EXPERIMENT	B	EN	LeRC
23	GFGAS	Gradient Furnace for Get-Away-Special	B	EN	LeRC
24	G-GPRF	GRADIENT GENERAL PURPOSE ROCKET FURNACE	D	EN	MSFC
25	GHF	GRADIENT HEATING FURNANCE	A	na	na
26	HAL	HIGH TEMPERATURE ACOUSTIC LEVITATOR	B	EN	MSFC

TABLE 2.1

PAYLOADS IN
RACO DATABASE

Date:03/02/88 Page A- 2

No.	Acronym	Item	Phase	Code	Center
27	IMF	Image Furnace	D	na	na
28	IBSE	INITIAL BLOOD STORAGE EXPERIMENT	D	EN	JSC
29	IEF	Isoelectric Focusing	D	EN	MSFC
30	IDGE	Isothermal Dendritic Growth Experment	C	EN	LeRC
31	I-GPRF	ISOTHERMAL GENERAL PURPOSE ROCKET FURN.	D	EN	MSFC
32	IHF	ISOTHERMAL HEATING FURNANCE	D	na	na
33	LPE	Lambda Point Experiment	C	EN	JPL
34	LIF	LARGE ISOTHERMAL FURNANCE	A	na	na
35	LDF	LIQUID DROP EXPERIMENT FACILITY	C	na	na
36	MIS	Magnetic Isolation System	C	IC	
37	MCU	MARANGONI CONVECTION UNIT	D	na	na
38	MGM	Mechanics of Granular Materials	C	EN	
39	-0-	MEPHISTO	D	na	na-
40	MHF	MIRROR HEATING FURNANCE	D	na	na
41	MLRS	Monodisperse Latex Reactor System	D	EN	MSFC
42	MWEU	Moving Wall Electrophoresis Unit	A	EN	MSFC
43	MEPF	Multiple Experiment Processing Furnace	C	IC	MSFC
44	NLOM	Non-Linear Optical Monomers	C	Code C	MSFC
45	NLOOC	Non-Linear Optical Organic Crystals	C	Code C	MSFC
46	NLOTF	Non-Linear Optical Thin Films	C	Code C	MSFC
47	NFF-1	Normal Freezing Furnace-1	C	IC	MSFC
48	OPCGF	Organic & Polymer Crystal Growth Facil.	B	IC	MSFC
49	OPPE	Organic and Polymer Processing Exper.	D	IC	MSFC
50	OCF	ORGANIC CRYSTAL GROWTH EXP. FACILITY	C	EN	MSFC
51	ORSEP	Organic Separations	C	Code C	MSFC
52	PCCE	Particle Cloud Combustion Experiment	C	EN	LeRC

TABLE 2.1

No.	Acronym	Item	Phase	Code	Center
53	PPE	Phase Partitioning Experiment	D	EN	MSFC
54	PVTOS	Physical Vapor Transport Of Organic Sol.	D	IC	MSFC
55	PCG1	Protein Crystal Growth I	D	EN	MSFC
56	PCG2/3	Protein Crystal Growth II/III	C	EN	MSFC
57	PCG4	Protein Crystal Growth IV	B	EN	MSFC
58	SAAL	Single Axis Acoustic Levitator	D	EN	MSFC
59	SSCE	Solid Surface Combustion Experiment	C	EN	LeRC
60	SURF	Space Ultra-Vacuum Reasearch Facility	B	IC	MSFC
61	SCES	Static Column Electrophoretic Separator	D	EN	MSFC
62	STDCE	Surface Tension Driven Convection Exp.	C	EN	LeRC
63	3AAL	Three Axis Acoustic Levitator	D	EN	JPL
64	VCGS	Vapor Crystal Growth System	D	EN	MSFC
65	ZCG	Zeolite Crystal Growth	A	IC	MSFC

Facility/Hardware Name:Ad. Automated Directional Solidification Abbr.:AADSF

The facility has the following physical chacateriscics:
Height (m): 1.20000
Width (m): 0.60000
Depth (m): 0.60000
Mass (kg): 120.000

The facility storage requirements:Storage of subsystem spares and user provided samples/materials
Required storage volume (cu m): 0.05000

Some Areas of interst:
Does this facility fit in a standard rack Y/N ?: y
If Yes, then is it a single (s) or double (d) rack: s
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:EAC/MSL
Does the facility protrude into the isle or rack subsystem volume (y/n): n
Describe any protrusions into the isle or subsystem volume:none
Describe the following if they exist in the facility:
Pressure vessels:EAC, type vessel
Windows:none
Other fracture risks:ampoules could fail in the EAC.
Special mounts:The system should be mounted so the samples length is parallel to the
gravity vector.

Facility/Hardware Name:Chemical Vapor Transport Abbr.:CVT

The facility has the following physical chacateriscics:
Height (m): 1.80000
Width (m): 1.06000
Depth (m): 0.80000
Mass (kg): 200.000

The facility storage requirements:30 kg, one middeck locker
Required storage volume (cu m): 0.00300

Some Areas of interst:
Does this facility fit in a standard rack Y/N ?: y
If Yes, then is it a single (s) or double (d) rack: d
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:middeck galley
Does the facility protrude into the isle or rack subsystem volume (y/n): y
Describe any protrusions into the isle or subsystem volume:the furnace cannisters
Describe the following if they exist in the facility:
Pressure vessels:ampoule,furnace wall
Windows:-0-
Other fracture risks:-0-
Special mounts:-0-

Facility/Hardware Name:Diffusive Mixing of Organic Solutions Abbr.:DMOS

===

The facility has the following physical chacateriscics:
Height (m):-0-
Width (m):-0-
Depth (m):-0-
Mass (kg):-0-

The facility storage requirements:Reactors are housed in EACs and returned in the same container.
Required storage volume (cu m):-0-

Some Areas of interst:
Does this facility fit in a standard rack Y/N ?: y
If Yes, then is it a single (s) or double (d) rack: s
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:-0-
Does the facility protrude into the isle or rack subsystem volume (y/n): n
Describe any protrusions into the isle or subsystem volume:-0-
Describe the following if they exist in the facility:
Pressure vessels:EAC
Windows:no
Other fracture risks:-0-
Special mounts:-0-

Facility/Hardware Name:ELECTROEPITAXIAL CRYSTAL GROWTH Abbr.:ECG

===

The facility has the following physical chacateriscics:

Height (m): 3.18000
Width (m): 0.89000
Depth (m): 1.52000
Mass (kg): 1865.00

The facility storage requirements:-0-

Required storage volume (cu m):-0-

Some Areas of interst:

Does this facility fit in a standard rack Y/N ?: Y
If Yes, then is it a single (s) or double (d) rack: D
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:-0-
Does the facility protrude into the isle or rack subsystem volume (y/n): N
Describe any protrusions into the isle or subsystem volume:-0-
Describe the following if they exist in the facility:
Pressure vessels:-0-
Windows:-0-
Other fracture risks:-0-
Special mounts:REQUIRES 3 DOUBLE RACKS.

Facility/Hardware Name:Electromagnetic Levitator Abbr.:EML

===

The facility has the following physical chacateriscics:
Height (m): 58.4000
Width (m): 35.6000
Depth (m): 35.6000
Mass (kg): 42.0000

The facility storage requirements:none as configured
Required storage volume (cu m):-0-

Some Areas of interst:
Does this facility fit in a standard rack Y/N ?: y
If Yes, then is it a single (s) or double (d) rack: s
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:designed for cargo bay.
Does the facility protrude into the isle or rack subsystem volume (y/n): n
Describe any protrusions into the isle or subsystem volume:-0-
Describe the following if they exist in the facility:
Pressure vessels:10E-9 torr chamber
Windows:-0-
Other fracture risks:-0-
Special mounts:-0-

Facility/Hardware Name:Float Zone Crystal Growth Facility Abbr.:FZCGF

The facility has the following physical chacateriscics:

Height (m):-0-
Width (m):-0-
Depth (m):-0-
Mass (kg):-0-

The facility storage requirements:Sample and support equipment are housed in an EAC.

Required storage volume (cu m):-0-

Some Areas of interst:

Does this facility fit in a standard rack Y/N ?: y
If Yes, then is it a single (s) or double (d) rack: s
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:n/a
Does the facility protrude into the isle or rack subsystem volume (y/n): n
Describe any protrusions into the isle or subsystem volume:n/a
Describe the following if they exist in the facility:

Pressure vessels:EAC
Windows:no
Other fracture risks:ampoule
Special mounts:n/a

Facility/Hardware Name:Fluid Experiment System Abbr.:FES

The facility has the following physical chacateriscics:

Height (m): 1.50000
Width (m): 1.10000
Depth (m): 0.70000
Mass (kg): 493.400

The facility storage requirements:Requires 122.6 kg of stored items. Fes test cells, film magazine, fuses, etc.
Required storage volume (cu m): 0.27000

Some Areas of interst:
Does this facility fit in a standard rack Y/N ?: y
If Yes, then is it a single (s) or double (d) rack: d
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:Spacelab double rack
Does the facility protrude into the isle or rack subsystem volume (y/n): n
Describe any protrusions into the isle or subsystem volume:-0-
Describe the following if they exist in the facility:
Pressure vessels:-0-
Windows:test cell
Other fracture risks:Optical components to optical bench
Special mounts:-0-

Facility/Hardware Name:HIGH TEMPERATURE ACOUSTIC LEVITATOR Abbr.:HAL

The facility has the following physical chacateriscics:
Height (m): 1.58000
Width (m): 1.06000
Depth (m): 0.86000
Mass (kg): 295.000

The facility storage requirements:STORAGE OF SAMPLE CARTRIDGES OF 15 TO 30 SAMPLES.
Required storage volume (cu m): 0.01000

Some Areas of interst:
Does this facility fit in a standard rack Y/N ?: Y
If Yes, then is it a single (s) or double (d) rack: D
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:-0-
Does the facility protrude into the isle or rack subsystem volume (y/n): N
Describe any protrusions into the isle or subsystem volume:-0-
Describe the following if they exist in the facility:
Pressure vessels:-0-
Windows:-0-
Other fracture risks:GLASS SAMPLES
Special mounts:-0-

Facility/Hardware Name:LIQUID DROP EXPERIMENT FACILITY Abbr.:LDF

The facility has the following physical chacateriscics:

Height (m): 0.35680
Width (m): 0.52600
Depth (m): 0.55000
Mass (kg): 28.0000

The facility storage requirements:STORED IN THE FACILITY.

Required storage volume (cu m): 0.00000

Some Areas of interst:

Does this facility fit in a standard rack Y/N ?: Y
If Yes, then is it a single (s) or double (d) rack: S
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:NONE
Does the facility protrude into the isle or rack subsystem volume (y/n): Y
Describe any protrusions into the isle or subsystem volume:HAND WHEELS INTRUDE INTO THE ISLE 3 IN.
Describe the following if they exist in the facility:
Pressure vessels:NONE
Windows:VIEWING WINDOW
Other fracture risks:NONE
Special mounts:NONE

Facility/Hardware Name:MOVING WALL ELECTROPHORESIS UNIT Abbr.:MWEU

===

The facility has the following physical chacateriscics:

Height (m): 2.75300
Width (m): 0.56400
Depth (m): 0.76000
Mass (kg): 255.000

The facility storage requirements:REFERGERATED STORAGE (10 TO 14 DEG C) OF BIOMATERIAL.
Required storage volume (cu m): 0.00400

Some Areas of interst:

Does this facility fit in a standard rack Y/N ?: Y
If Yes, then is it a single (s) or double (d) rack: S
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:SPACELAB SINGLE RACK
Does the facility protrude into the isle or rack subsystem volume (y/n): N
Describe any protrusions into the isle or subsystem volume:-0-
Describe the following if they exist in the facility:
Pressure vessels:1.1 ATM SEPAR. CHMB.
Windows:POLYCARBONATE PLT.
Other fracture risks:NO
Special mounts:-0-

Facility/Hardware Name:Multiple Experiment Processing Furnace Abbr.:MEPF

The facility has the following physical chacateriscics:

Height (m): 1.50000
Width (m): 0.40000
Depth (m): 0.40000
Mass (kg): 250.000

The facility storage requirements:sample carousel with 20 samples, Helium tanks for quenching

Required storage volume (cu m):-0-

Some Areas of interst:

Does this facility fit in a standard rack Y/N ?: y
If Yes, then is it a single (s) or double (d) rack: d
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:designed for MSL (EAC)
Does the facility protrude into the isle or rack subsystem volume (y/n): y
Describe any protrusions into the isle or subsystem volume:sample carousel may protude
Describe the following if they exist in the facility:

Pressure vessels:ampoule, EAC
Windows:no
Other fracture risks:2500 psi He tanks for quenching
Special mounts:Facility must be reconfigured for standard rack.

Facility/Hardware Name:Normal Freexing Furnace-1 Abbr.:NFF-1

The facility has the following physical chacateriscics:

Height (m): 0.70000
Width (m): 0.20000
Depth (m): 0.20000
Mass (kg): 68.0000

The facility storage requirements:2 Furnace systems, control and data aquisition system.
Required storage volume (cu m):-0-

Some Areas of interst:

Does this facility fit in a standard rack Y/N ?: y
If Yes, then is it a single (s) or double (d) rack: d
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:EAC
Does the facility protrude into the isle or rack subsystem volume (y/n): n
Describe any protrusions into the isle or subsystem volume:n/a
Describe the following if they exist in the facility:
Pressure vessels:ampoule
Windows:no
Other fracture risks:ampoule failure
Special mounts:n/a

Facility/Hardware Name:Organic and Polymer Crystal Growth fac. Abbr.:OPCGF

The facility has the following physical chacateriscics:

Height (m):-0-
Width (m):-0-
Depth (m):-0-
Mass (kg):-0-

The facility storage requirements:samples stored in EAC and sample containers

Required storage volume (cu m):-0-

Some Areas of interst:

Does this facility fit in a standard rack Y/N ?: y
If Yes, then is it a single (s) or double (d) rack: d
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:-0-
Does the facility protrude into the isle or rack subsystem volume (y/n): n
Describe any protrusions into the isle or subsystem volume:-0-
Describe the following if they exist in the facility:

Pressure vessels:no
Windows:-0-
Other fracture risks:-0-
Special mounts:-0-

Facility/Hardware Name:Physical Vapor Transport of Organic sol. Abbr.:PVTOS

===

The facility has the following physical chacateriscics:
Height (m):-0-
Width (m):-0-
Depth (m):-0-
Mass (kg): 74.9000

The facility storage requirements:-0-
Required storage volume (cu m):-0-

Some Areas of interst:
Does this facility fit in a standard rack Y/N ?: Y
If Yes, then is it a single (s) or double (d) rack: S
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:-0-
Does the facility protrude into the isle or rack subsystem volume (y/n): N
Describe any protrusions into the isle or subsystem volume:-0-
Describe the following if they exist in the facility:
Pressure vessels:Test cells, EAC
Windows:-0-
Other fracture risks:cells contained in EAC
Special mounts:-0-

Facility/Hardware Name:Protein Crystal Growth IV Abbr.:PCG-IV

===

The facility has the following physical chacateriscics:
Height (m): 1.60000
Width (m): 0.40000
Depth (m): 0.70000
Mass (kg): 120.000

The facility storage requirements:Storage of 8 kg of reservoir solutions, protein buffers, alsts, etc.
Required storage volume (cu m): 0.01000

Some Areas of interst:
Does this facility fit in a standard rack Y/N ?: y
If Yes, then is it a single (s) or double (d) rack: s
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:-0-
Does the facility protrude into the isle or rack subsystem volume (y/n): y
Describe any protrusions into the isle or subsystem volume:Robotic sample mechanism
Describe the following if they exist in the facility:
Pressure vessels:-0-
Windows:-0-
Other fracture risks:Glass containers
Special mounts:Must be mounted such that robotics arm has forward clearance of at least 20
cm.

Facility/Hardware Name:Three Axis Acoustic Levitator Abbr.:3AAL

===

The facility has the following physical chacateriscics:

Height (m): 0.70000
Width (m): 0.40000
Depth (m): 0.40000
Mass (kg): 125.000

The facility storage requirements:-0-

Required storage volume (cu m):-0-

Some Areas of interst:

Does this facility fit in a standard rack Y/N ?: Y
If Yes, then is it a single (s) or double (d) rack: S
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will mount in, describe:EAC cannister on the MSL
Does the facility protrude into the isle or rack subsystem volume (y/n): -
Describe any protrusions into the isle or subsystem volume:-0-
Describe the following if they exist in the facility:

Pressure vessels:EAC
Windows:-0-
Other fracture risks:-0-
Special mounts:Item designed for MSL. Must be modified for rack.

Facility/Hardware Name:Vapor Crystal Growth System Abbr.:VCGS

===

The facility has the following physical chacateriscics:

Height (m): 2.00000
Width (m): 0.40000
Depth (m): 0.50000
Mass (kg): 74.2100

The facility storage requirements:VCGS experiment modules at 4 kg each, 15.0 x 9.5 x 9.5 per run.

Required storage volume (cu m): 0.00170

Some Areas of interst:

Does this facility fit in a standard rack Y/N ?: y
If Yes, then is it a single (s) or double (d) rack: s
Does the facility fit into a std. mid deck locker Y/N:
If Yes, then how many does this facility require:
If there is some other standard carrier that the facility will
mount in, describe:single spacelab rack
Does the facility protrude into the isle or rack subsystem volume (y/n): y
Describe any protrusions into the isle or subsystem volume:Microscope pertrudes 16.5 cm.
Describe the following if they exist in the facility:
Pressure vessels:ampoule
Windows:-0-
Other fracture risks:-0-
Special mounts:Must be modified for Space Station rack. Requires FES hardware to provide power and control.

Facility/Hardware Name:Ad.Automated Directional Solidification Abbr:AADSF

The facility has the following power system requirements:
AC (watts): 0.00000AC Voltage: 0.00000AC Frequency (Hz): 0.00000 AC Phase: 0
DC (watts): 1000.00DC Voltage: 28.0000

The facility has the following special power system requiements:
The AADSF must have a Power conditioner.

The facility has the following power system failure requirements:
The experiment would be lost, no Hazards

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts): 200.000 Ideal Air temperature (deg C): 5.00000
Surface temperature of the air cooled item (degC): 1400.00(Max) 200.000 (Min)

Fluid Loop System:
Fluid loop thermal load (watts): 800.000 Ideal fluid temperature (deg C): 20.0000
Temperatures of the fluid cooled item (deg C): 90.0000(Max) 2.00000 (Min)
Highest temperature of the fluid leaving the item (deg C): 5.00000

Other Cooling:
Other system thermal load (watts): 100.000
Other system description:Argon
Temperature of the cooled items (deg C): 100.000(Max) 0.00000 (Min)

Facility/Hardware Name:Chemical Vapor Transport Abbr:CVT

The facility has the following power system requirements:
AC (watts): 150.000AC Voltage:-0- AC Frequency (Hz): 540.000 AC Phase:-0-
DC (watts): 150.000DC Voltage: 28.0000

The facility has the following special power system requiements:
-0-

The facility has the following power system failure requirements:
loss of cooling

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts): 150.000 Ideal Air temperature (deg C): 20.0000
Surface temperature of the air cooled item (degC): 75.0000(Max) 28.0000 (Min)

Fluid Loop System:
Fluid loop thermal load (watts): 480.000 Ideal fluid temperature (deg C): 80.0000
Temperatures of the fluid cooled item (deg C): 500.000(Max) 80.0000 (Min)
Highest temperature of the fluid leaving the item (deg C): 40.0000

Other Cooling:
Other system thermal load (watts):-0-
Other system description:-0-
Temperature of the cooled items (deg C): -0- (Max) -0- (Min)

Facility/Hardware Name:Diffusive Mixing of Organic Solutions Abbr:DMOS

The facility has the following power system requirements:
AC (watts):-0- AC Voltage:-0- AC Frequency (Hz):-0- AC Phase:-0-
DC (watts):-0- DC Voltage: 28.0000

The facility has the following special power system requiements:
Operational power for the GEM

The facility has the following power system failure requirements:
Discontinuity in mixing of solutions.

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts):-0- Ideal Air temperature (deg C):-0-
Surface temperature of the air cooled item (degC):-0- (Max) -0- (Min)

Fluid Loop System:
Fluid loop thermal load (watts):-0- Ideal fluid temperature (deg C):-0-
Temperatures of the fluid cooled item (deg C): -0- (Max) -0- (Min)
Highest temperature of the fluid leaving the item (deg C):-0-

Other Cooling:
Other system thermal load (watts):-0-
Other system description:-0-
Temperature of the cooled items (deg C): -0- (Max) -0- (Min)

Facility/Hardware Name:ELECTROEPITAXIAL CRYSTAL GROWTH Abbr:ECG

The facility has the following power system requirements:
AC (watts): 0.00000AC Voltage:-0- AC Frequency (Hz):-0- AC Phase:-0-
DC (watts): 6000.00DC Voltage: 28.0000

The facility has the following special power system requiements:
PARALLEL OPERATION UPTO 27 KW.

The facility has the following power system failure requirements:
-0-

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts):-0- Ideal Air temperature (deg C):-0-
Surface temperature of the air cooled item (degC):-0- (Max) -0- (Min)

Fluid Loop System:
Fluid loop thermal load (watts): 6000.00 Ideal fluid temperature (deg C): 45.0000
Temperatures of the fluid cooled item (deg C): 300.000(Max) 20.0000 (Min)
Highest temperature of the fluid leaving the item (deg C): 20.0000

Other Cooling:
Other system thermal load (watts):-0-
Other system description:-0-
Temperature of the cooled items (deg C): -0- (Max) -0- (Min)

Facility/Hardware Name:Electromagnetic Levitator Abbr:EML

The facility has the following power system requirements:
AC (watts):-0- AC Voltage:-0- AC Frequency (Hz):-0- AC Phase:-0-
DC (watts): 1204.00DC Voltage: 28.0000

The facility has the following special power system requiements:
-0-

The facility has the following power system failure requirements:
-0-

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts):-0- Ideal Air temperature (deg C):-0-
Surface temperature of the air cooled item (degC):-0- (Max) -0- (Min)

Fluid Loop System:
Fluid loop thermal load (watts): 1204.00 Ideal fluid temperature (deg C): 80.0000
Temperatures of the fluid cooled item (deg C): 600.000(Max) 100.000 (Min)
Highest temperature of the fluid leaving the item (deg C): 40.0000

Other Cooling:
Other system thermal load (watts):-0-
Other system description:-0-
Temperature of the cooled items (deg C): -0- (Max) -0- (Min)

Facility/Hardware Name:Float Zone Crystal Growth Faciltiy   Abbr:FZCGF

The facility has the following power system requirements:
AC (watts):-0-   AC Voltage:-0-   AC Frequency (Hz):-0-   AC Phase:-0-
DC (watts):-0-   DC Voltage: 28.0000

The facility has the following special power system requiements:
sample heat-up to produce float zone.

The facility has the following power system failure requirements:
-0-

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts):-0-   Ideal Air temperature (deg C):-0-
Surface temperature of the air cooled item (degC):-0-   (Max)   -0-   (Min)

Fluid Loop System:
Fluid loop thermal load (watts):-0-   Ideal fluid temperature (deg C):-0-
Temperatures of the fluid cooled item (deg C):   -0-   (Max)   -0-   (Min)
Highest temperature of the fluid leaving the item (deg C):-0-

Other Cooling:
Other system thermal load (watts):-0-
Other system description:-0-
Temperature of the cooled items (deg C):   -0-   (Max)   -0-   (Min)

Facility/Hardware Name:Fluid Experiment System Abbr:FES

The facility has the following power system requirements:
AC (watts): 694.000AC Voltage:-0- AC Frequency (Hz):-0- AC Phase:-0-
DC (watts): 790.000DC Voltage: 28.0000

The facility has the following special power system requiements:
-0-

The facility has the following power system failure requirements:
-0-

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts): 519.000 Ideal Air temperature (deg C): 10.0000
Surface temperature of the air cooled item (degC): 200.000(Max) 15.0000 (Min)

Fluid Loop System:
Fluid loop thermal load (watts): 3028.00 Ideal fluid temperature (deg C): 20.0000
Temperatures of the fluid cooled item (deg C): 60.0000(Max) 15.0000 (Min)
Highest temperature of the fluid leaving the item (deg C): 10.0000

Other Cooling:
Other system thermal load (watts):-0-
Other system description:-0-
Temperature of the cooled items (deg C): -0- (Max) -0- (Min)

Facility/Hardware Name:HIGH TEMPERATURE ACOUSTIC LEVITATOR Abbr:HAL

The facility has the following power system requirements:
AC (watts): 120.000AC Voltage:-0- AC Frequency (Hz):-0- AC Phase:-0-
DC (watts): 2880.00DC Voltage: 28.0000

The facility has the following special power system requiements:
-0-

The facility has the following power system failure requirements:
-0-

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts): 120.000 Ideal Air temperature (deg C): 20.0000
Surface temperature of the air cooled item (degC): 45.0000(Max) 20.0000 (Min)

Fluid Loop System:
Fluid loop thermal load (watts): 2880.00 Ideal fluid temperature (deg C): 90.0000
Temperatures of the fluid cooled item (deg C): 500.000(Max) 100.000 (Min)
Highest temperature of the fluid leaving the item (deg C): 45.0000

Other Cooling:
Other system thermal load (watts):-0-
Other system description:-0-
Temperature of the cooled items (deg C): -0- (Max) -0- (Min)

Facility/Hardware Name:LIQUID DROP EXPERIMENT FACILITY Abbr:LDF

The facility has the following power system requirements:
AC (watts): 0.00000AC Voltage: 0.00000AC Frequency (Hz): 0.00000 AC Phase: 0
DC (watts): 33.8000DC Voltage: 28.0000

The facility has the following special power system requiements:
NONE

The facility has the following power system failure requirements:
LOSS OF EXPERIMENT, FACILITY WILL BE OK.

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts): 170.000 Ideal Air temperature (deg C): 15.0000
Surface temperature of the air cooled item (degC): 20.0000(Max) 20.0000 (Min)

Fluid Loop System:
Fluid loop thermal load (watts): 0.00000 Ideal fluid temperature (deg C): 0.00000
Temperatures of the fluid cooled item (deg C): 0.00000(Max) 0.00000 (Min)
Highest temperature of the fluid leaving the item (deg C): 0.00000

Other Cooling:
Other system thermal load (watts): 0.00000
Other system description:NONE
Temperature of the cooled items (deg C): 0.00000(Max) 0.00000 (Min)

Facility/Hardware Name:MOVING WALL ELECTROPHORESIS UNIT Abbr:MWEU

The facility has the following power system requirements:

AC (watts):-0- AC Voltage:-0- AC Frequency (Hz):-0- AC Phase:-0-

DC (watts): 1000.00DC Voltage: 28.0000

The facility has the following special power system requiements:

-0-

The facility has the following power system failure requirements:

SAMPLE WOULD DIFFUSE BACK INTO THE BUFFR

The facility has the following thermal system requirements:

Avionics System:

Avionics thermal load (watts): 200.000 Ideal Air temperature (deg C): 10.0000

Surface temperature of the air cooled item (degC): 45.0000(Max) 15.0000 (Min)

Fluid Loop System:

Fluid loop thermal load (watts): 800.000 Ideal fluid temperature (deg C): 20.0000

Temperatures of the fluid cooled item (deg C): 22.0000(Max) 12.0000 (Min)

Highest temperature of the fluid leaving the item (deg C): 10.0000

Other Cooling:

Other system thermal load (watts):-0-

Other system description:-0-

Temperature of the cooled items (deg C): -0- (Max) -0- (Min)

Facility/Hardware Name:Multiple Experiment Processing Furnace Abbr:MEPF

The facility has the following power system requirements:
AC (watts):-0- AC Voltage:-0- AC Frequency (Hz):-0- AC Phase:-0-
DC (watts): 1000.00DC Voltage: 28.0000

The facility has the following special power system requiements:
-0-

The facility has the following power system failure requirements:
loss of experiment

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts): 350.000 Ideal Air temperature (deg C): 5.00000
Surface temperature of the air cooled item (degC): 1600.00(Max) 400.000 (Min)

Fluid Loop System:
Fluid loop thermal load (watts): 950.000 Ideal fluid temperature (deg C): 20.0000
Temperatures of the fluid cooled item (deg C): -0- (Max) -0- (Min)
Highest temperature of the fluid leaving the item (deg C): 5.00000

Other Cooling:
Other system thermal load (watts): 4920.00
Other system description:helium
Temperature of the cooled items (deg C): 100.000(Max) -0- (Min)

Facility/Hardware Name:Normal Freezing Furnace-1 Abbr:NFF-1

The facility has the following power system requirements:
AC (watts): 0.00000AC Voltage: 0.00000AC Frequency (Hz):-0- AC Phase:-0-
DC (watts): 1100.00DC Voltage: 28.0000

The facility has the following special power system requiements:
-0-

The facility has the following power system failure requirements:
loss of experiment

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts): 175.000 Ideal Air temperature (deg C): 5.00000
Surface temperature of the air cooled item (degC): 800.000(Max) 400.000 (Min)

Fluid Loop System:
Fluid loop thermal load (watts): 700.000 Ideal fluid temperature (deg C): 20.0000
Temperatures of the fluid cooled item (deg C): -0- (Max) -0- (Min)
Highest temperature of the fluid leaving the item (deg C): 5.00000

Other Cooling:
Other system thermal load (watts): 100.000
Other system description:inert gas
Temperature of the cooled items (deg C): 100.000(Max) -0- (Min)

==

Facility/Hardware Name:Organic and Polymer Crystal Growth Fac. Abbr:OPCGF

The facility has the following power system requirements:

AC (watts):-0- AC Voltage:-0- AC Frequency (Hz):-0- AC Phase:-0-
DC (watts):-0- DC Voltage: 28.0000

The facility has the following special power system requiements:
-0-

The facility has the following power system failure requirements:
-0-

The facility has the following thermal system requirements:

Avionics System:

Avionics thermal load (watts):-0- Ideal Air temperature (deg C):-0-
Surface temperature of the air cooled item (degC):-0- (Max) -0- (Min)

Fluid Loop System:

Fluid loop thermal load (watts):-0- Ideal fluid temperature (deg C):-0-
Temperatures of the fluid cooled item (deg C): -0- (Max) -0- (Min)
Highest temperature of the fluid leaving the item (deg C):-0-

Other Cooling:

Other system thermal load (watts):-0-
Other system description:-0-
Temperature of the cooled items (deg C): -0- (Max) -0- (Min)

Facility/Hardware Name:Physical Vapor Transport of Organic Sol. Abbr:PVTOS

The facility has the following power system requirements:
AC (watts):-0- AC Voltage:-0- AC Frequency (Hz):-0- AC Phase:-0-
DC (watts):-0- DC Voltage: 28.0000

The facility has the following special power system requiements:
-0-

The facility has the following power system failure requirements:
-0-

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts):-0- Ideal Air temperature (deg C):-0-
Surface temperature of the air cooled item (degC):-0- (Max) -0- (Min)

Fluid Loop System:
Fluid loop thermal load (watts):-0- Ideal fluid temperature (deg C):-0-
Temperatures of the fluid cooled item (deg C): -0- (Max) -0- (Min)
Highest temperature of the fluid leaving the item (deg C):-0-

Other Cooling:
Other system thermal load (watts):-0-
Other system description:-0-
Temperature of the cooled items (deg C): -0- (Max) -0- (Min)

Facility/Hardware Name:Protein Crystal Growth-IV Abbr:PCG-IV

The facility has the following power system requirements:
AC (watts): 160.000AC Voltage:-0- AC Frequency (Hz):-0- AC Phase:-0-
DC (watts): 60.0000DC Voltage:-0-

The facility has the following special power system requiements:
-0-

The facility has the following power system failure requirements:
Variable temp nullifies scientific retur

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts): 100.000 Ideal Air temperature (deg C): 18.0000
Surface temperature of the air cooled item (degC): 60.0000(Max) 4.00000 (Min)

Fluid Loop System:
Fluid loop thermal load (watts): 120.000 Ideal fluid temperature (deg C): 25.0000
Temperatures of the fluid cooled item (deg C): 25.0000(Max) 4.00000 (Min)
Highest temperature of the fluid leaving the item (deg C): 4.00000

Other Cooling:
Other system thermal load (watts):-0-
Other system description:-0-
Temperature of the cooled items (deg C): -0- (Max) -0- (Min)

Facility/Hardware Name:Three Axis Acoustic Levitator Abbr:3AAL

The facility has the following power system requirements:
AC (watts):-0- AC Voltage: 0.00000AC Frequency (Hz):-0- AC Phase:-0-
DC (watts): 280.000DC Voltage: 28.0000

The facility has the following special power system requiements:
n/a

The facility has the following power system failure requirements:
-0-

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts):-0- Ideal Air temperature (deg C):-0-
Surface temperature of the air cooled item (degC):-0- (Max) -0- (Min)

Fluid Loop System:
Fluid loop thermal load (watts): 280.000 Ideal fluid temperature (deg C):-0-
Temperatures of the fluid cooled item (deg C): 25.0000(Max) -0- (Min)
Highest temperature of the fluid leaving the item (deg C):-0-

Other Cooling:
Other system thermal load (watts):-0-
Other system description:-0-
Temperature of the cooled items (deg C): -0- (Max) -0- (Min)

Facility/Hardware Name:Vapor Crystal Growth System Abbr:VCGS

The facility has the following power system requirements:
AC (watts): 60.0000AC Voltage:-0- AC Frequency (Hz):-0- AC Phase:-0-
DC (watts): 458.0000DC Voltage: 28.0000

The facility has the following special power system requiements:
FES provides power conditioning

The facility has the following power system failure requirements:
-0-

The facility has the following thermal system requirements:

Avionics System:
Avionics thermal load (watts): 225.000 Ideal Air temperature (deg C): 18.0000
Surface temperature of the air cooled item (degC): 35.0000(Max) 10.0000 (Min)

Fluid Loop System:
Fluid loop thermal load (watts): 233.000 Ideal fluid temperature (deg C): 80.0000
Temperatures of the fluid cooled item (deg C): 120.000(Max) 80.0000 (Min)
Highest temperature of the fluid leaving the item (deg C): 40.0000

Other Cooling:
Other system thermal load (watts):-0-
Other system description:-0-
Temperature of the cooled items (deg C): -0- (Max) -0- (Min)

Facility/Hardware Name:Ad. Automated Directional Solidification Abbr:AADSF

The following Abbrevations are used in this table:

Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment							Discharged from the Experiment					
	Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
Air	L	Outside Rack	G	0.224	175.00	-0-	1.00000	V	G	0.224	175.0	-0-	0.00100
								Storage of output material:					
Comments:Used to refill the facility.								Risk: Toxic- N Reactive- N Flammable-N					
Argon	L	Outside Rack	G	0.312	175.00	-0-	1.00000	V	G	0.312	175.0	-0-	0.00100
								Storage of output material:					
Comments:Gas required to fill enclosure.								Risk: Toxic- N Reactive- N Flammable-N					
Cleaning Fluid	L	Outside Rack	L	0.500	0.5000	-0-	1.00000	W	L	0.500	0.500	-0-	1.00000
								Storage of output material:					
Comments:Used to clean the facility.								Risk: Toxic- N Reactive- N Flammable-N					
Distilled Water	L	Outside Rack	L	2.000	2.0000	-0-	1.00000	W	L	2.000	2.000	-0-	1.00000
								Storage of output material:					
Comments:Used to clean the facility.								Risk: Toxic- N Reactive- N Flammable-N					
Semiconductor Matl.	U	In Rack	S	0.631	0.0788	-0-	1.00000	C	S	0.631	0.079	-0-	1.00000
								Storage of output material:					
Comments:Sample to be returned to Earth.								Risk: Toxic- Y Reactive- N Flammable-N					

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 3.66630(kg) Total Volume Inputed: 352.579(liters)
Total Mass Outputed: 3.66630(kg) Total Volume Outputed: 352.579(liters)

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Facility/Hardware Name:Chemical Vapor Transport Abbr:CVT

The following Abbrevations are used in this table:
Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment: Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Discharged from the Experiment: Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
Semiconductors	U	In Facility	S	0.100	0.0200	-0-	1.00000	C	S	0.100	0.020	-0-	1.00000
								Storage of output material:					
Comments:Various Semiconductors								Risk: Toxic- Y Reactive- N Flammable-N					

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 0.10000(kg) Total Volume Inputed: 0.02000(liters)
Total Mass Outputed: 0.10000(kg) Total Volume Outputed: 0.02000(liters)

Facility/Hardware Name:Diffusive Mixing of Organic Solutions Abbr:DMOS

The following Abbrevations are used in this table:
Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment							Discharged from the Experiment					
	Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
Organic Solutions	U	EAC	L	0.258	0.1288	-0-	1.00000	C	L	0.258	0.129	-0-	1.00000
								Storage of output material:					
Comments:Cyanine tosyliate, triethylamm onium oxonol are processed.								Risk: Toxic- Y Reactive- Y Flammable-Y					

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 0.25760(kg) Total Volume Inputed: 0.12880(liters)
Total Mass Outputed: 0.25760(kg) Total Volume Outputed: 0.12880(liters)

Facility/Hardware Name:Electroepitaxial Crystal Growth Abbr:ECG

The following Abbrevations are used in this table:
Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment: Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Discharged from the Experiment: Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
GH2	L	Outside Rack	G	0.007	83.000	-0-	10.0000	V	G	0.007	83.00	-0-	0.00100
								Storage of output material:					
Comments:Will contain traces of Gallium Arsenid.								Risk: Toxic- Y Reactive- Y Flammable-Y					

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 0.00750(kg) Total Volume Inputed: 83.0000(liters)
Total Mass Outputed: 0.00750(kg) Total Volume Outputed: 83.0000(liters)

Facility/Hardware Name:Electromagnetic Levitator Abbr:EML

The following Abbrevations are used in this table:
Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment: Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Discharged from the Experiment: Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
Metals and Alloys	U	In Rack	S	0.100	0.0130	-0-	1.00000	C	S	0.100	0.130	-0-	1.00000
								Storage of output material:					
Comments:Various Metals and Alloys								Risk: Toxic- N Reactive- N Flammable-N					

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 0.10000(kg) Total Volume Inputed: 0.01300(liters)
Total Mass Outputed: 0.10000(kg) Total Volume Outputed: 0.13000(liters)

Facility/Hardware Name:Float Zone Crystal Growth Facility Abbr:FZCGF

The following Abbrevations are used in this table:
Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment: Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Discharged from the Experiment: Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
Silicon, Semicond.	U	In Facility (EAC)	S	0.631	0.0788	-0-	1.00000	C	S	0.631	0.079	-0-	1.00000
Comments:Material being processed is contained.								Storage of output material: Risk: Toxic- Y Reactive- N Flammable-Y					

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 0.63080(kg) Total Volume Inputed: 0.07880(liters)
Total Mass Outputed: 0.63080(kg) Total Volume Outputed: 0.07880(liters)

Facility/Hardware Name:Fluid Experiment System Abbr:FES

The following Abbrevations are used in this table:
Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment: Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Discharged from the Experiment: Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
Model Fluids	U	In Rack	L	1.000	1.0000	-0-	1.00000	C	L	1.000	1.000	-0-	1.00000
								Storage of output material:					
Comments:Various Model Fluids								Risk: Toxic- Y Reactive- N Flammable-N					

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 1.00000(kg) Total Volume Inputed: 1.00000(liters)
Total Mass Outputed: 1.00000(kg) Total Volume Outputed: 1.00000(liters)

Facility/Hardware Name:High Temperature Acoustic Levitator Abbr:HAL

The following Abbrevations are used in this table:

Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment: Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Discharged from the Experiment: Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
GN2	L	Outside Rack	G	0.116	90.000	-0-	1.00000	V	G	0.116	90.00	-0-	0.00100
								Storage of output material:					
Comments:May contain traces of sample material.								Risk: Toxic- N Reactive- N Flammable-N					

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 0.11570(kg) Total Volume Inputed: 90.0000(liters)
Total Mass Outputed: 0.11570(kg) Total Volume Outputed: 90.0000(liters)

Facility/Hardware Name:LIQUID DROP EXPERIMENT FACILITY Abbr:LDF

The following Abbrevations are used in this table:

Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment							Discharged from the Experiment					
	Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
GN2	L	FROM FACILITY	G	0.000	0.0011	0.01000	1.00000	V	G	0.000	0.001	0.01000	1.00000
Comments:COVER GAS.								Storage of output material: Risk: Toxic- N Reactive- N Flammable-N					
SILICON OIL	U	IN FACILITY	L	0.010	0.0100	0.01000	1.00000	W	L	0.010	0.010	0.01000	1.00000
Comments:SAMPLE MATERIAL								Storage of output material: Risk: Toxic- N Reactive- N Flammable-N					

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 0.01005(kg) Total Volume Inputed: 0.01110(liters)
Total Mass Outputed: 0.01005(kg) Total Volume Outputed: 0.01110(liters)

Facility/Hardware Name:Moving Wall Electrophoresis Unit Abbr:MWEU

The following Abbrevations are used in this table:

Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment: Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Discharged from the Experiment: Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
Biomaterial	U	In Middeck Locker	L	4.000	4.0000	0.00560	1.10000	C	L	4.000	4.000	0.00560	1.00000
Comments:Finial product is mixed with a saline/water buffer solution.								Storage of output material: Risk: Toxic- N Reactive- N Flammable-N					

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 4.00000(kg) Total Volume Inputed: 4.00000(liters)
Total Mass Outputed: 4.00000(kg) Total Volume Outputed: 4.00000(liters)

Facility/Hardware Name:Multiple Experiment Processing Furnace Abbr:MEPF

The following Abbrevations are used in this table:
Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment: Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Discharged from the Experiment: Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
Air	L	Outside Rack	G	0.224	175.00	-0-	1.00000	V	G	0.224	175.0	-0-	0.00100
Comments:Used to refill the faciltiy.								Storage of output material: Risk: Toxic- N Reactive- N Flammable-N					
Argon	L	Outside Rack	G	0.312	175.00	-0-	1.00000	V	G	0.312	175.0	-0-	0.00100
Comments:used to fill furnace module.								Storage of output material: Risk: Toxic- N Reactive- N Flammable-N					
Cleaning Fluid	L	Outside Rack	L	0.500	0.5000	-0-	1.00000	W	L	0.500	0.500	-0-	1.00000
Comments:Used to clean the facility. May have traces of toxic waste.								Storage of output material: Risk: Toxic- N Reactive- N Flammable-N					
Distilled water	L	Outside Rack	L	2.000	2.0000	-0-	1.00000	W	L	2.000	2.000	-0-	1.00000
Comments:Used to clean the facility.								Storage of output material: Risk: Toxic- N Reactive- N Flammable-N					
Helium	L	Outside Rack	G	0.001	4.0000	-0-	17.0000	V	G	0.001	4.000	-0-	0.00100
Comments:Used for quenching sample. May contain toxic elements.								Storage of output material: Risk: Toxic- Y Reactive- N Flammable-N					
Metals and Alloys	U	In Facility	S	0.700	0.1300	-0-	1.00000	C	S	0.700	0.130	-0-	1.00000
Comments:Sample to be returned to earth.								Storage of output material: Risk: Toxic- Y Reactive- N Flammable-N					

The following gives the total masses and volumes of materials required by this facility:
Total Mass Inputed: 3.73621(kg) Total Volume Inputed: 356.630(liters)
Total Mass Outputed: 3.73621(kg) Total Volume Outputed: 356.630(liters)

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Facility/Hardware Name:Normal Freezing Furnace-1 Abbr:NFF-1

The following Abbrevations are used in this table:
Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment: Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Discharged from the Experiment: Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
Air	L	Outside Rack	G	0.224	175.00	-0-	1.00000	V	G	0.224	175.0	-0-	0.00100
Comments:Used to refill the facility.								Storage of output material: Risk: Toxic- N Reactive- N Flammable-N					
Argon	L	Outside Rack	G	0.312	175.00	-0-	1.00000	V	G	0.312	175.0	-0-	0.00100
Comments:Gas required to fill enclosure.								Storage of output material: Risk: Toxic- N Reactive- N Flammable-N					
Cleaning Fluid	L	Outside rack	L	0.500	0.5000	-0-	1.00000	W	L	0.500	0.500	-0-	1.00000
Comments:Used to clean the facility.								Storage of output material: Risk: Toxic- N Reactive- N Flammable-N					
Distilled Water	L	Outside rack	L	2.000	2.0000	-0-	1.00000	W	L	2.000	2.000	-0-	1.00000
Comments:Used to clean the facility.								Storage of output material: Risk: Toxic- N Reactive- N Flammable-N					
Seniconductor Matl.	U	In Rack	S	0.631	0.0788	-0-	1.00000	C	S	0.631	0.079	-0-	1.00000
Comments:Sample to be returned to Earth.								Storage of output material: Risk: Toxic- Y Reactive- Y Flammable-N					

The following gives the total masses and volumes of materials required by this facility:
Total Mass Inputed: 3.66630(kg) Total Volume Inputed: 352.579(liters)
Total Mass Outputed: 3.66630(kg) Total Volume Outputed: 352.579(liters)

Facility/Hardware Name:Organic and Polymer Crystal Growth Fac. Abbr:OPCGF

The following Abbrevations are used in this table:
Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment							Discharged from the Experiment					
	Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
Organic Solutions	U	In Facility (EAC)	S	0.435	0.4570	-0-	1.00000	C	S	36.70	33.36	-0-	1.00000

Comments:Organic solutions, solids, and polydiacetylene processed.

Storage of output material:
Risk: Toxic- Y Reactive- Y Flammable-Y

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 0.43500(kg) Total Volume Inputed: 0.45700(liters)
Total Mass Outputed: 36.6960(kg) Total Volume Outputed: 33.3600(liters)

Facility/Hardware Name:Physical Vapor Transport of Organic Sol. Abbr:PVTOS

The following Abbrevations are used in this table:
Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment							Discharged from the Experiment					
	Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
Organic Solutions	U	EAC (self contained)	S	1.042	1.0425	-0-	1.00000	C	S	1.042	1.043	-0-	1.00000
Comments:Sample material is contained in test cells and EAC.								Storage of output material: Risk: Toxic- N Reactive- N Flammable-N					

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 1.04250(kg) Total Volume Inputed: 1.04250(liters)
Total Mass Outputed: 1.04250(kg) Total Volume Outputed: 1.04260(liters)

Facility/Hardware Name:Protein Crystal Growth-IV Abbr:PCG-IV

The following Abbrevations are used in this table:
Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment							Discharged from the Experiment					
	Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
Proteins	U	In Rack	L	0.100	0.1000	-0-	1.00000	C	L	0.100	0.100	-0-	1.00000
								Storage of output material:					
Comments:Various Proteins								Risk: Toxic- N Reactive- N Flammable-N					

The following gives the total masses and volumes of materials required by this facility:
Total Mass Inputed: 0.10000(kg) Total Volume Inputed: 0.10000(liters)
Total Mass Outputed: 0.10000(kg) Total Volume Outputed: 0.10000(liters)

Facility/Hardware Name:Three Axis Acoustic Levitator Abbr:3AAL

The following Abbrevations are used in this table:
Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

Materials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment: Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Discharged from the Experiment: Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
GN2	L	Outside Rack	G	0.003	1.6800	-0-	1.00000	V	G	0.003	1.680	-0-	0.00100
								Storage of output material:					
Comments:Used to fill the experiment volume.								Risk: Toxic- N Reactive- N Flammable-N					

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 0.00299(kg) Total Volume Inputed: 1.68000(liters)
Total Mass Outputed: 0.00290(kg) Total Volume Outputed: 1.68000(liters)

acility/Hardware Name:Vapor Crystal Growth System Abbr:VCGS

he following Abbrevations are used in this table:

Source: L = Lab provided;
G = Generated as a product of the facility run;
U = User provided, a special consumable that is unique:

Dispose: W = Waste;
V = Vented;
C = Consumed/converted in the facility:

Phase: G = Gasoues
L = Liquid
S = Solid

aterials Used by This Facility are given in this table:

Material Name	Supplied to the Experiment							Discharged from the Experiment					
	Source	Storage Requirements	Material Phase	Mass (kg)	Volume (liter)	Flow Rate (kg/min)	Pressure (atm)	Dispose	Phase	Mass (kg)	Volume (l)	Flow Rate (kg/min)	Pressure (atm)
emiconductors	U	In Rack	S	0.100	0.0200	-0-	1.00000	C	S	0.100	0.020	-0-	1.00000
								Storage of output material:					
omments:Various Semiconductors								Risk: Toxic- Y Reactive- N Flammable-N					

The following gives the total masses and volumes of materials required by this facility:

Total Mass Inputed: 0.10000(kg) Total Volume Inputed: 0.02000(liters)
Total Mass Outputed: 0.10000(kg) Total Volume Outputed: 0.02000(liters)

Facility/Hardware Name:Ad. Automated Directional Solidification
Abbr:AADSF

The facility has the following Data requirements:

Peak Data Rate: 2000.00(kBps)
Duration at Peak: 5.00000(min)
Average Data Rate: 100.000 (kBps)
Duration Total: 14400.0(min)
Peak Uplink Data Rate: 50.0000(kBps)
Duration of Uplink: 5.00000(min)
Mass Storage for On-orbit Data: 216.000(Mbit)

The Facility has the following Audio requirements:

Audio Duration between the ground and the Lab: 60.0000(min)
Describe the audio requirement:Facility operation and sample prep.

The Facility has the following Video system requirements:

Video feild of view X: 0.03000x Y: 0.04000(cm)
Video depth of feild: 0.02000(cm)
Video resolution: 8.00000(cm)
Video Color resolution: 1.00000(bits)
Video Frame rate: 1(fps)
Video duration at highest resolution: 0.02000(min)
Video to the ground Y/N:y
Describe the information that is sent to the ground:
One frame of the product w/microscope.
How often is this video to the ground needed:intermit. during run

Facility/Hardware Name:Chemical Vapor Transport
Abbr:CVT

The facility has the following Data requirements:

- Peak Data Rate:-0- (kBps)
- Duration at Peak:-0- (min)
- Average Data Rate:-0- (kBps)
- Duration Total: -0- (min)
- Peak Uplink Data Rate:-0- (kBps)
- Duration of Uplink: -0- (min)
- Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:

- Audio Duration between the ground and the Lab:-0- (min)
- Describe the audio requirement:-0-

The Facility has the following Video system requirements:

- Video feild of view X:-0- x Y:-0- (cm)
- Video depth of feild:-0- (cm)
- Video resolution:-0- (cm)
- Video Color resolution:-0- (bits)
- Video Frame rate:-0- (fps)
- Video duration at highest resolution:-0- (min)
- Video to the ground Y/N:n
- Describe the information that is sent to the ground:
  -0-
- How often is this video to the ground needed:-0-

Facility/Hardware Name:Diffusive Mixing of Organic Solutions
Abbr:DMOS

The facility has the following Data requirements:
Peak Data Rate:-0- (kBps)
Duration at Peak:-0- (min)
Average Data Rate:-0- (kBps)
Duration Total: -0- (min)
Peak Uplink Data Rate:-0- (kBps)
Duration of Uplink: -0- (min)
Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:
Audio Duration between the ground and the Lab:-0- (min)
Describe the audio requirement:-0-

The Facility has the following Video system requirements:
Video feild of view X:-0- x Y:-0- (cm)
Video depth of feild:-0- (cm)
Video resolution:-0- (cm)
Video Color resolution:-0- (bits)
Video Frame rate:-0- (fps)
Video duration at highest resolution:-0- (min)
Video to the ground Y/N:-
Describe the information that is sent to the ground:
-0-
How often is this video to the ground needed:-0-

Facility/Hardware Name:ELECTROEPITAXIAL CRYSTAL GROWTH
Abbr:ECG

The facility has the following Data requirements:
- Peak Data Rate: 2.00000(kBps)
- Duration at Peak:-0- (min)
- Average Data Rate: 2.00000 (kBps)
- Duration Total: 2.22000(min)
- Peak Uplink Data Rate: 2.00000(kBps)
- Duration of Uplink: 0.28000(min)
- Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:
- Audio Duration between the ground and the Lab: 30.0000(min)
- Describe the audio requirement:OPERATIONAL VERIFICATION

The Facility has the following Video system requirements:
- Video feild of view X:-0- x Y:-0- (cm)
- Video depth of feild:-0- (cm)
- Video resolution:-0- (cm)
- Video Color resolution:-0- (bits)
- Video Frame rate:-0- (fps)
- Video duration at highest resolution:-0- (min)
- Video to the ground Y/N:-
- Describe the information that is sent to the ground:
  -0-
- How often is this video to the ground needed:24

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Facility/Hardware Name:Electromagnetic Levitator
Abbr:EML

The facility has the following Data requirements:
Peak Data Rate:-0- (kBps)
Duration at Peak:-0- (min)
Average Data Rate:-0- (kBps)
Duration Total: -0- (min)
Peak Uplink Data Rate:-0- (kBps)
Duration of Uplink: -0- (min)
Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:
Audio Duration between the ground and the Lab:-0- (min)
Describe the audio requirement:-0-

The Facility has the following Video system requirements:
Video feild of view X:-0- x Y:-0- (cm)
Video depth of feild:-0- (cm)
Video resolution:-0- (cm)
Video Color resolution:-0- (bits)
Video Frame rate:-0- (fps)
Video duration at highest resolution:-0- (min)
Video to the ground Y/N:-
Describe the information that is sent to the ground:
-0-
How often is this video to the ground needed:-0-

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Facility/Hardware Name:Float Zone Crystal Growth Faciltiy
Abbr:FZCGF

The facility has the following Data requirements:
Peak Data Rate:-0- (kBps)
Duration at Peak:-0- (min)
Average Data Rate:-0- (kBps)
Duration Total: -0- (min)
Peak Uplink Data Rate:-0- (kBps)
Duration of Uplink: -0- (min)
Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:
Audio Duration between the ground and the Lab:-0- (min)
Describe the audio requirement:-0-

The Facility has the following Video system requirements:
Video feild of view X:-0- x Y:-0- (cm)
Video depth of feild:-0- (cm)
Video resolution:-0- (cm)
Video Color resolution:-0- (bits)
Video Frame rate:-0- (fps)
Video duration at highest resolution:-0- (min)
Video to the ground Y/N:-
Describe the information that is sent to the ground:
-0-
How often is this video to the ground needed:-0-

Facility/Hardware Name:Fluid Experiment System
Abbr:FES

The facility has the following Data requirements:
Peak Data Rate:-0- (kBps)
Duration at Peak:-0- (min)
Average Data Rate: 20.0000 (kBps)
Duration Total: -0- (min)
Peak Uplink Data Rate:-0- (kBps)
Duration of Uplink: -0- (min)
Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:
Audio Duration between the ground and the Lab:-0- (min)
Describe the audio requirement:-0-

The Facility has the following Video system requirements:
Video feild of view X: 5.00000x Y: 5.00000(cm)
Video depth of feild: 10.0000(cm)
Video resolution: 8.00000(cm)
Video Color resolution: 4.00000(bits)
Video Frame rate: 30(fps)
Video duration at highest resolution:-0- (min)
Video to the ground Y/N:y
Describe the information that is sent to the ground:
10 Mbps for 5 seconds.
How often is this video to the ground needed:-0-

Facility/Hardware Name:HIGH TEMPERATURE ACOUSTIC LEVITATOR
Abbr:HAL

The facility has the following Data requirements:

Peak Data Rate: 3.00000(kBps)
Duration at Peak: 15.0000(min)
Average Data Rate: 2.00000 (kBps)
Duration Total: -0- (min)
Peak Uplink Data Rate: 2.00000(kBps)
Duration of Uplink: 15.0000(min)
Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:

Audio Duration between the ground and the Lab: 30.0000(min)
Describe the audio requirement:VERIFICATION AND ADJUSTMENTS

The Facility has the following Video system requirements:

Video feild of view X:-0- x Y:-0- (cm)
Video depth of feild:-0- (cm)
Video resolution:-0- (cm)
Video Color resolution:-0- (bits)
Video Frame rate:-0- (fps)
Video duration at highest resolution:-0- (min)
Video to the ground Y/N:Y
Describe the information that is sent to the ground:
-0-
How often is this video to the ground needed:5

Facility/Hardware Name:LIQUID DROP EXPERIMENT FACILITY
Abbr:LDF

The facility has the following Data requirements:
- Peak Data Rate: 1.00000(kBps)
- Duration at Peak: 109.000(min)
- Average Data Rate: 1.00000 (kBps)
- Duration Total: 109.000(min)
- Peak Uplink Data Rate: 1.00000(kBps)
- Duration of Uplink: 5.00000(min)
- Mass Storage for On-orbit Data: 7.00000(Mbit)

The Facility has the following Audio requirements:
- Audio Duration between the ground and the Lab: 102.000(min)
- Describe the audio requirement:CREW INTERACTION WITH THE GROUND PI.

The Facility has the following Video system requirements:
- Video feild of view X: 10.0000x Y: 11.0000(cm)
- Video depth of feild: 10.0000(cm)
- Video resolution: 8.00000(cm)
- Video Color resolution: 1.00000(bits)
- Video Frame rate: 30(fps)
- Video duration at highest resolution: 94.0000(min)
- Video to the ground Y/N:Y
- Describe the information that is sent to the ground:
  SELECTIVE DATA AFTER THE RUN.
- How often is this video to the ground needed:1

Facility/Hardware Name:Moving Wall Electrophoresis Unit
Abbr:MWEU

The facility has the following Data requirements:
- Peak Data Rate: 0.30000(kBps)
- Duration at Peak: 360.000(min)
- Average Data Rate: 0.29200 (kBps)
- Duration Total: 756.000(min)
- Peak Uplink Data Rate:-0- (kBps)
- Duration of Uplink: -0- (min)
- Mass Storage for On-orbit Data: 0.21600(Mbit)

The Facility has the following Audio requirements:
- Audio Duration between the ground and the Lab:-0- (min)
- Describe the audio requirement:-0-

The Facility has the following Video system requirements:
- Video feild of view X:-0- x Y:-0- (cm)
- Video depth of feild:-0- (cm)
- Video resolution:-0- (cm)
- Video Color resolution:-0- (bits)
- Video Frame rate:-0- (fps)
- Video duration at highest resolution:-0- (min)
- Video to the ground Y/N:-
- Describe the information that is sent to the ground:
  -0-
- How often is this video to the ground needed:-0-

Facility/Hardware Name:Multiple Experiment Processing Furnace
Abbr:MEPF

The facility has the following Data requirements:
Peak Data Rate: 20.0000(kBps)
Duration at Peak: 20.0000(min)
Average Data Rate: 20.0000 (kBps)
Duration Total: 20.0000(min)
Peak Uplink Data Rate:-0- (kBps)
Duration of Uplink: -0- (min)
Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:
Audio Duration between the ground and the Lab: 20.0000(min)
Describe the audio requirement:Facility preparation for operation.

The Facility has the following Video system requirements:
Video feild of view X:-0- x Y:-0- (cm)
Video depth of feild:-0- (cm)
Video resolution:-0- (cm)
Video Color resolution:-0- (bits)
Video Frame rate:-0- (fps)
Video duration at highest resolution:-0- (min)
Video to the ground Y/N:-
Describe the information that is sent to the ground:
-0-
How often is this video to the ground needed:-0-

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Facility/Hardware Name:Normal Freezing Furnace-1
Abbr:NFF-1

The facility has the following Data requirements:
Peak Data Rate: 20.0000(kBps)
Duration at Peak: 5.00000(min)
Average Data Rate: 20.0000 (kBps)
Duration Total: 60.0000(min)
Peak Uplink Data Rate:-0- (kBps)
Duration of Uplink: -0- (min)
Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:
Audio Duration between the ground and the Lab: 20.0000(min)
Describe the audio requirement:Facility preparation for operation.

The Facility has the following Video system requirements:
Video feild of view X:-0- x Y:-0- (cm)
Video depth of feild:-0- (cm)
Video resolution:-0- (cm)
Video Color resolution:-0- (bits)
Video Frame rate:-0- (fps)
Video duration at highest resolution:-0- (min)
Video to the ground Y/N:-
Describe the information that is sent to the ground:
-0-
How often is this video to the ground needed:-0-

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Facility/Hardware Name:Organic and Polymer Crystal Growth Fac.
Abbr:OPCGF

The facility has the following Data requirements:
Peak Data Rate:-0- (kBps)
Duration at Peak:-0- (min)
Average Data Rate:-0- (kBps)
Duration Total: -0- (min)
Peak Uplink Data Rate:-0- (kBps)
Duration of Uplink: -0- (min)
Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:
Audio Duration between the ground and the Lab:-0- (min)
Describe the audio requirement:-0-

The Facility has the following Video system requirements:
Video feild of view X:-0- x Y:-0- (cm)
Video depth of feild:-0- (cm)
Video resolution:-0- (cm)
Video Color resolution:-0- (bits)
Video Frame rate:-0- (fps)
Video duration at highest resolution:-0- (min)
Video to the ground Y/N:-
Describe the information that is sent to the ground:
-0-
How often is this video to the ground needed:-0-

Facility/Hardware Name:Physical Vapor Transport of Organic Sol.
Abbr:PVTOS

The facility has the following Data requirements:
- Peak Data Rate:-0- (kBps)
- Duration at Peak:-0- (min)
- Average Data Rate:-0- (kBps)
- Duration Total: -0- (min)
- Peak Uplink Data Rate:-0- (kBps)
- Duration of Uplink: -0- (min)
- Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:
- Audio Duration between the ground and the Lab:-0- (min)
- Describe the audio requirement:-0-

The Facility has the following Video system requirements:
- Video feild of view X:-0- x Y:-0- (cm)
- Video depth of feild:-0- (cm)
- Video resolution:-0- (cm)
- Video Color resolution:-0- (bits)
- Video Frame rate:-0- (fps)
- Video duration at highest resolution:-0- (min)
- Video to the ground Y/N:-
- Describe the information that is sent to the ground: -0-
- How often is this video to the ground needed:-0-

Facility/Hardware Name:Protein Crystal Growth-IV
Abbr:PCG-IV

The facility has the following Data requirements:
Peak Data Rate:-0- (kBps)
Duration at Peak:-0- (min)
Average Data Rate:-0- (kBps)
Duration Total: -0- (min)
Peak Uplink Data Rate:-0- (kBps)
Duration of Uplink: -0- (min)
Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:
Audio Duration between the ground and the Lab:-0- (min)
Describe the audio requirement:-0-

The Facility has the following Video system requirements:
Video feild of view X:-0- x Y:-0- (cm)
Video depth of feild:-0- (cm)
Video resolution:-0- (cm)
Video Color resolution:-0- (bits)
Video Frame rate:-0- (fps)
Video duration at highest resolution:-0- (min)
Video to the ground Y/N:-
Describe the information that is sent to the ground:
-0-
How often is this video to the ground needed:-0-

Facility/Hardware Name:Three Axis Acoustic Levitator
Abbr:3AAL

The facility has the following Data requirements:
Peak Data Rate:-0- (kBps)
Duration at Peak:-0- (min)
Average Data Rate:-0- (kBps)
Duration Total: -0- (min)
Peak Uplink Data Rate:-0- (kBps)
Duration of Uplink: -0- (min)
Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:
Audio Duration between the ground and the Lab:-0- (min)
Describe the audio requirement:-0-

The Facility has the following Video system requirements:
Video feild of view X:-0- x Y:-0- (cm)
Video depth of feild:-0- (cm)
Video resolution:-0- (cm)
Video Color resolution:-0- (bits)
Video Frame rate:-0- (fps)
Video duration at highest resolution:-0- (min)
Video to the ground Y/N:-
Describe the information that is sent to the ground:
-0-
How often is this video to the ground needed:-0-

Facility/Hardware Name:Vapor Crystal Growth System
Abbr:VCGS

The facility has the following Data requirements:
Peak Data Rate: 20.0000(kBps)
Duration at Peak:-0- (min)
Average Data Rate: 20.0000 (kBps)
Duration Total: -0- (min)
Peak Uplink Data Rate:-0- (kBps)
Duration of Uplink: -0- (min)
Mass Storage for On-orbit Data:-0- (Mbit)

The Facility has the following Audio requirements:
Audio Duration between the ground and the Lab: 5.00000(min)
Describe the audio requirement:monitor and adjust as PI prescribes

The Facility has the following Video system requirements:
Video feild of view X:-0- x Y:-0- (cm)
Video depth of feild:-0- (cm)
Video resolution:-0- (cm)
Video Color resolution:-0- (bits)
Video Frame rate:-0- (fps)
Video duration at highest resolution:-0- (min)
Video to the ground Y/N:y
Describe the information that is sent to the ground:
-0-
How often is this video to the ground needed:every hour

Facility:Ad. Automated Directional Solidification Acronym:AADSF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	Ground to station activities.	-0-	-0-	-0-	-0-	-0-	-0	These steps include all ground based and transportation operations.
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.1	Ground preparation of samples.	-0-	-0-	-0-	-0-	-0-	-0	
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.1.1	Ground prepartion of sample.	-0-	-0-	-0-	-0-	-0-	-0	
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.1.2	Move sample into ampoules and seal them.	120.000	0.00000	-0-	-0-	-0-	-0	
NO		120.000	0.00000	0.00000	0.00000	0.00000		
1.2	Transport samples and unique equip. to Space Sta.	-0-	-0-	-0-	-0-	-0-	-0	
NO		120.000	0.00000	0.00000	0.00000	0.00000		
1.2.1	Secure samples into furnace module.	10.0000	0.00000	-0-	-0-	-0-	-0	
NO		130.000	0.00000	0.00000	0.00000	0.00000		
1.2.2	Secure facility into experiment rack.	60.0000	0.00000	-0-	-0-	-0-	-0	
NO		190.000	0.00000	0.00000	0.00000	0.00000		

Facility:Ad. Automated Directional Solidification Acronym:AADSF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.2.3	Secure experiment rack, containing the facility, into logistics module.	60.0000	0.00000	-0-	-0-	-0-	-0	
NO		250.000	0.00000	0.00000	0.00000	0.00000		
2.0	Transport experimental facility from logistics module to carrier.	120.000	120.000	-0-	-0-	-0-	-0	These steps will be performed once at the begining of the mission.
NO		370.000	120.000	0.00000	0.00000	0.00000		
2.1	Secure experiment rack in carrier location assigned for mission.	60.0000	60.0000	-0-	-0-	-0-	-0	
NO		430.000	180.000	0.00000	0.00000	0.00000		
2.2	Connect required interfaces to rack.	20.0000	20.0000	-0-	-0-	-0-	-0	
NO		450.000	200.000	0.00000	0.00000	0.00000		
2.3	Verify all connections and check for leaks.	30.0000	30.0000	0.00000	0.00000	-0-	-0	
NO		480.000	230.000	0.00000	0.00000	0.00000		
3.0	Review experiment for preparation of run.	10.0000	10.0000	-0-	-0-	-0-	-0	These steps will be accomplished prior to each and every run.
YE		490.000	240.000	0.00000	0.00000	0.00000		
3.1.1	Review experimental procedures.	10.0000	10.0000	0.00000	0.00000	-0-	-0	
YE		500.000	250.000	0.00000	0.00000	0.00000		

Facility:Ad. Automated Directional Solidification Acronym:AADSF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
3.1.2	Move sample into the furnace.	-0-	-0-	0.00000	0.00000	-0-	-0	
YE		500.000	250.000	0.00000	0.00000	0.00000		
3.1.3	Secure furnace.	-0-	-0-	0.00000	0.00000	-0-	-0	
YE		500.000	250.000	0.00000	0.00000	0.00000		
3.2.1	Secure all connections and seals.	10.0000	10.0000	0.00000	0.00000	-0-	-0	
YE		510.000	260.000	0.00000	0.00000	0.00000		
3.2.2	Turn-on processor facility.	1.00000	1.00000	0.35000	0.35000	-0-	-0	Processor = 350 W
YE		511.000	261.000	0.00583	0.00583	0.00000		
3.2.3	Turn-on master controller system, power conditioner, heater controller, and data recorder	5.00000	5.00000	0.35000	0.35000	-0-	-0	SEE 3.2.2
YE		516.000	266.000	0.02917	0.02917	0.00000		
3.2.4	Run system integrity test.	5.00000	1.00000	-0-	-0-	-0-	-0	
YE		521.000	267.000	0.00000	0.00000	0.00000		
4.0	Run.	-0-	-0-	-0-	-0-	-0-	-0	These steps include the actual running of the facility.
YE		521.000	267.000	0.00000	0.00000	0.00000		

Functional Flow
Analysis of the Commercial
Carriers Hardware

Date:03/04/88

Facility:Ad. Automated Directional Solidification   Acronym:AADSF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.1	Run process.	-0-	-0-	-0-	-0-	-0-	-0	
YE		521.000	267.000	0.00000	0.00000	0.00000		
4.1.1	Adjust processing parameters.	10.0000	10.0000	0.35000	0.35000	-0-	-0	SEE 3.2.2
YE		531.000	277.000	0.05833	0.05833	0.00000		
4.1.2	Run furnace and sample heat-up.	120.000	2.00000	1.00000	0.50000	0.50000	-0	Peak heat rejection is 2500 W increasing from 350 W at 52.44 W/min
YE		651.000	279.000	2.00000	1.00000	3600.00		
4.1.3	Run process to sample soak	300.000	12.0000	0.90000	0.90000	0.50000	-0	-0-
YE		951.000	291.000	4.50000	4.50000	9000.00		
4.1.4	Run process to grow crystal.	14400.0	600.000	0.90000	0.90000	0.50000	-0	Power equal heat loss plus SEE 3.2.2
YE		15351.0	891.000	216.000	216.000	432000.		
4.1.5	Turn-off furnace and allow it to cool-down.	180.000	8.00000	0.35000	0.90000	0.50000	-0	Heat rejection start at 2500 W decreasing to 350 W at end of period
YE		15531.0	899.000	1.05000	2.70000	5400.00		
4.2	Run end.	-0-	-0-	-0-	-0-	-0-	-0	
YE		15531.0	899.000	0.00000	0.00000	0.00000		

Facility:Ad. Automated Directional Solidification Acronym:AADSF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.2.1	Disassemble furnace as required to remove module.	120.000	120.000	0.35000	0.35000	-0-	-0	SEE 3.2.2
YE		15651.0	1019.00	0.70000	0.70000	0.00000		
4.2.2	Move ampoules from heater module to glovebox.	20.0000	20.0000	0.35000	0.35000	-0-	-0	SEE 3.2.2
YE		15671.0	1039.00	0.11667	0.11667	0.00000		
4.2.3	Turn-off controller.	1.00000	1.00000	0.00000	0.00000	-0-	-0	
YE	.	15672.0	1040.00	0.00000	0.00000	0.00000		
5.0	Remove ampoule from furnace module and translation devic.	10.0000	10.0000	0.00000	0.00000	0.00000	0	-0-
NO		15682.0	1050.00	0.00000	0.00000	0.00000		
5.1	Package ampoules in shock resistant containers for safe return to earth.	30.0000	30.0000	-0-	-0-	-0-	-0	These steps will be deleted from the IOC mission analysis.
NO		15712.0	1080.00	0.00000	0.00000	0.00000		
6.0	Run IOC level characterization.	-0-	-0-	-0-	-0-	-0-	-0	These steps will be performed during the IOC period
NO		15712.0	1080.00	0.00000	0.00000	0.00000		
6.1	Review and analyze product.	-0-	-0-	-0-	-0-	-0-	-0	
NO		15712.0	1080.00	0.00000	0.00000	0.00000		

Facility:Ad. Automated Directional Solidification Acronym:AADSF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
6.1.01	View and photograph boule through wall of ampoule.	10.0000	10.0000	0.00000	0.00000	-0-	-0	
NO		15722.0	1090.00	0.00000	0.00000	0.00000		
6.1.02	Disassemble ampoule and remove boule from ampoule.	30.0000	30.0000	0.20000	0.20000	-0-	-0	Glovebox = 200 W
NO		15752.0	1120.00	0.10000	0.10000	0.00000		
6.1.03	Operate etching equipment to etch growth residue from product.	30.0000	30.0000	0.20000	0.20000	-0-	-0	Glovebox = 200 W
NO		15782.0	1150.00	0.10000	0.10000	0.00000		
6.1.04	View and photograph product.	10.0000	10.0000	0.20000	0.20000	-0-	-0	SEE 5.1.3
NO		15792.0	1160.00	0.03333	0.03333	0.00000		
6.1.05	Operate mass measurement device and measure mass of boule.	20.0000	20.0000	0.22000	0.22000	-0-	-0	Glovebox = 200 W; Mass measurement = 20 W
NO		15812.0	1180.00	0.07333	0.07333	0.00000		
6.1.06	Operate dimensional device to measure physical dimensions of boule.	10.0000	10.0000	0.20000	0.20000	-0-	-0	SEE 5.1.3
NO		15822.0	1190.00	0.03333	0.03333	0.00000		
6.1.07	Operate cutting unit to slice sample wafer from boule.	40.0000	40.0000	0.95000	0.95000	-0-	-0	Glovebox = 200 W; Cutting/Polishing = 750 W
NO		15862.0	1230.00	0.63333	0.63333	0.00000		

Facility:Ad. Automated Directional Solidification Acronym:AADSF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
6.1.08	View and photograph wafers.	10.0000	10.0000	0.20000	0.20000	-0-	-0	SEE 5.1.3
NO		15872.0	1240.00	0.03333	0.03333	0.00000		
6.1.09	Operate polishing device to polish wafers.	40.0000	40.0000	0.95000	0.95000	-0-	-0	SEE 5.1.7
NO		15912.0	1280.00	0.63333	0.63333	0.00000		
6.1.10	View and photograph wafer using microscope system.	40.0000	40.0000	0.15000	0.15000	-0-	-0	Microscope system = 150 W
NO		15952.0	1320.00	0.10000	0.10000	0.00000		
6.1.11	Operate etching device to etch wafer.	30.0000	30.0000	0.20000	0.20000	-0-	-0	Glovebox = 200 W
NO		15982.0	1350.00	0.10000	0.10000	0.00000		
6.1.12	View and photograph wafer using microscope system.	40.0000	40.0000	0.12000	0.12000	-0-	-0	SEE 5.1:10
NO		16022.0	1390.00	0.08000	0.08000	0.00000		
6.1.13	Repeat 6.1:11 and 6.1:12 as required.	70.0000	70.0000	0.18000	0.18000	-0-	-0	Avg Power for steps
NO		16092.0	1460.00	0.21000	0.21000	0.00000		
6.2	Verify wafer crystal structure.	-0-	-0-	-0-	-0-	-0-	-0	
NO		16092.0	1460.00	0.00000	0.00000	0.00000		

Facility:Ad. Automated Directional Solidification Acronym:AADSF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
6.2.1	View wafer using x-ray system (topography).	180.000	180.000	1.50000	1.50000	-0-	-0	X-ray system (topography) = 1500 W
NO		16272.0	1640.00	4.50000	4.50000	0.00000		
6.2.2	Operate Hall probe to analyze wafer.	40.0000	40.0000	0.50000	0.50000	-0-	-0	Hall probe = 500 W
NO		16312.0	1680.00	0.33333	0.33333	0.00000		
6.2.3	Operate electricalconductivity probe to alyze wafer.	20.0000	20.0000	0.01500	0.01500	-0-	-0	Electrical conductivity probe = 15W
NO		16332.0	1700.00	0.00500	0.00500	0.00000		
6.2.4	Operate FTIR to analyze wafer.	40.0000	40.0000	1.50000	1.50000	0.00000	0	-0-
NO		16372.0	1740.00	1.00000	1.00000	0.00000		
7.0	Review data.	-0-	-0-	-0-	-0-	-0-	-0	These steps will be performed for both the IOC and Growth missions.
NO		16372.0	1740.00	0.00000	0.00000	0.00000		
7.1	Secure and store products.	30.0000	30.0000	0.20000	0.20000	-0-	-0	Glovebox = 200 W plus 3.1.1
NO		16402.0	1770.00	0.10000	0.10000	0.00000		
7.2	Review post experiment data.	-0-	-0-	-0-	-0-	-0-	-0	
NO		16402.0	1770.00	0.00000	0.00000	0.00000		

Facility:Ad. Automated Directional Solidification Acronym:AADSF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
7.2.1	Verify data as required.	30.0000	30.0000	0.00000	0.00000	-0-	-0	
NO		16432.0	1800.00	0.00000	0.00000	0.00000		
7.2.2	Verify correlation of experimental parameters to results.	30.0000	30.0000	0.00000	0.00000	-0-	-0	
NO		16462.0	1830.00	0.00000	0.00000	0.00000		
7.2.3	Review next run parameters.	60.0000	60.0000	0.00000	0.00000	-0-	-0	
NO		16522.0	1890.00	0.00000	0.00000	0.00000		
8.0	Clean equipment.	-0-	-0-	-0-	-0-	-0-	-0	These steps will be performed at the end of the 90 day mission or when needed.
NO		16522.0	1890.00	0.00000	0.00000	0.00000		
8.1	Clean equipment as needed.	30.0000	30.0000	0.00000	0.00000	-0-	-0	
NO		16552.0	1920.00	0.00000	0.00000	0.00000		
8.2	Secure equipment as needed.	90.0000	90.0000	0.00000	0.00000	-0-	-0	
NO		16642.0	2010.00	0.00000	0.00000	0.00000		
	TOTALS	Run Time	Crew Time	Eng. In	Eng. Out	Data		
		16642.0	2010.00	232.528	233.178	0.00000		

Facility:Chemical Vapor Transport   Acronym:CVT

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	Ground based operations.	-0-	-0-	C.00000	0.00000	0.00000	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	Initial setup.	-0-	-0-	0.00000	0.00000	0.00000	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.1	Transport facility from resupply module and inteface to carrier location.	120.000	120.000	0.00000	0.00000	0.00000	-0	-0-
NO		120.000	120.000	0.00000	0.00000	0.00000		
2.2	Secure facility in place for operation.	30.0000	30.0000	0.00000	0.00000	0.00000	-0	-0-
NO		150.000	150.000	0.00000	0.00000	0.00000		
2.3	Verify proper connections and check for leaks.	10.0000	10.0000	0.00000	0.00000	0.00000	-0	-0-
NO		160.000	160.000	0.00000	0.00000	0.00000		
2.4	Review experiment procedures.	30.0000	30.0000	0.00000	0.00000	0.00000	-0	-0-
NO		190.000	190.000	0.00000	0.00000	0.00000		
2.5	Turn on CVT main power switches.	1.00000	1.00000	0.06000	0.06000	0.00000	-0	-0-
NO		191.000	191.000	0.00100	0.00100	0.00000		

Facility:Chemical Vapor Transport Acronym:CVT

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
2.6	Turn on master controller/sequencer, data recorder, and GRID.	1.00000	1.00000	0.21000	0.21000	0.00000	-0	-0-
NO		192.000	192.000	0.00350	0.00350	0.00000		
2.7	Run self test program.	1.00000	1.00000	0.21000	0.21000	0.00000	-0	-0-
NO		193.000	193.000	0.00350	0.00350	0.00000		
2.8	Disengage launch locks on growth cartridges and test to verify full range of motion.	2.00000	2.00000	0.21000	0.21000	0.00000	-0	-0-
NO		195.000	195.000	0.00700	0.00700	0.00000		
3.1	Insert film into bath cameras and connect to controller.	3.00000	3.00000	0.21000	0.21000	0.00000	-0	-0-
YE		198.000	198.000	0.01050	0.01050	0.00000		
3.2	Turn on heater controller and run self test program.	8.00000	8.00000	0.21000	0.21000	0.00000	-0	-0-
YE		206.000	206.000	0.02800	0.02800	0.00000		
3.4	Verify cannister pressure at 1 psi.	1.00000	1.00000	0.21000	0.21000	0.00000	-0	-0-
YE		207.000	207.000	0.00350	0.00350	0.00000		
4.01	Run warm-up phase by activating the GRID.	30.0000	2.00000	0.69000	0.21000	0.20000	-0	-0-
YE		237.000	209.000	0.34500	0.10500	360.000		

Facility:Chemical Vapor Transport

Acronym:CVT

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.02	Verify proper temperature ramp.	2.00000	2.00000	0.69000	0.24000	0.20000	-0	-0-
YE		239.000	211.000	0.02300	0.00800	24.0000		
4.03	Heat up completion.	28.0000	0.00000	0.69000	0.67000	0.20000	-0	-0-
YE		267.000	211.000	0.32200	0.31267	336.000		
4.04	Verify proper core temperature	1.00000	1.00000	0.69000	0.69000	0.20000	-0	-0-
YE		268.000	212.000	0.01150	0.01150	12.0000		
4.05	Insert ampoules into the proper growth position.	1.00000	1.00000	0.69000	0.69000	0.20000	-0	-0-
YE		269.000	213.000	0.01150	0.01150	12.0000		
4.06	Run initial growth step.	30.0000	0.00000	0.69000	0.70000	0.20000	-0	-0-
YE		299.000	213.000	0.34500	0.35000	360.000		
4.07	View crystals and verify acceptable growth quality.	30.0000	30.0000	0.69000	0.70000	0.20000	-0	-0-
YE		329.000	243.000	0.34500	0.35000	360.000		
4.08	Adjust ampoules as necessary to obtain acceptable growth.	15.0000	15.0000	0.69000	0.70000	0.20000	-0	-0-
YE		344.000	258.000	0.17250	0.17500	180.000		

Facility:Chemical Vapor Transport Acronym:CVT

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.09	Assemble camera mounts and activate cameras once growth is acceptable	15.0000	15.0000	0.69000	0.70000	0.20000	M3	-0-
YE		359.000	273.000	0.17250	0.17500	180.000		
4.10	Run growth sequence and verify proper growth quality and change film in cameras as needed.	3284.00	60.0000	0.69000	0.73000	0.20000	-0	-0-
YE		3643.00	333.000	37.7660	39.9553	39408.0		
4.11	Run furnace cool-down sequence.	79.0000	0.00000	0.21000	0.21000	0.20000	-0	-0-
YE		3722.00	333.000	0.27650	0.27650	948.000		
4.12	Remove and stow camera sequence.	15.0000	15.0000	0.21000	0.21000	-0-	-0	-0-
YE		3737.00	348.000	0.05250	0.05250	0.00000		
5.1	Remove anmpoules to landing position.	2.00000	2.00000	0.21000	0.21000	-0-	-0	Hardware should be modified for sample change out.
NO		3739.00	350.000	0.00700	0.00700	0.00000		
5.2	Turn-off master power switch.	1.00000	1.00000	0.00000	0.00000	-0-	-0	Hardware should be modified for sample change out.
NO		3740.00	351.000	0.00000	0.00000	0.00000		
5.2	Turn-off master controller/sequencer, data recorder, heater controller, anmd GRID.	2.00000	2.00000	0.00000	0.21000	-0-	-0	Hardware should be modified for sample change out.
NO		3742.00	353.000	0.00000	0.00700	0.00000		
	TOTALS	Run Time	Crew Time	Eng. In	Eng. Out	Data		
		3742.00	353.000	39.9070	41.8540	0.00000		

Facility:DIFFUSIVE MIXING OF ORGANIC SOLUTIONS   Acronym:DMOS

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn. (kB)	Video Key 1	Comments
1.0	GROUND ACTIVITIES	-0-	-0-	-0-	-0-	-0-	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	REVIEW EXPERIMENT PROCEDURES	30.0000	30.0000	0.00000	0.00000	0.00000	N	-0-
NO		30.0000	30.0000	0.00000	0.00000	0.00000		
2.1	INSTALL UNIQUE EQUIPMENT IN FACILITY	30.0000	30.0000	0.00000	0.00000	0.00000	N	OBSERVE FUNDAMENTAL SAFETY PROCEDURES
NO		60.0000	60.0000	0.00000	0.00000	0.00000		
2.2	INTERFACE EQUIPMENT IN MID-DECK LOCKER	30.0000	30.0000	0.00000	0.00000	0.00000	N	OBSERVE FUNDAMENTAL SAFETY PROCEDURES
NO		90.0000	90.0000	0.00000	0.00000	0.00000		
2.3	INSERT THE EAC INTO THE MID-DECK LOCKER	5.00000	5.00000	0.02500	0.00000	0.00000	N	-0-
NO		95.0000	95.0000	0.00208	0.00000	0.00000		
3.0	PREPARE FOR EXPERIMENT RUN REVIEW START UP PROCEDURES	10.0000	10.0000	0.00000	0.00000	0.00000	N	-0-
YE		105.000	105.000	0.00000	0.00000	0.00000		
3.1	RUN MASTER CONTROLLER SYSTEM AND INTEGRITY TEST PROGRAM	5.00000	5.00000	0.07000	0.07000	0.00000	N	-0-
YE		110.000	110.000	0.00583	0.00583	0.00000		

Facility:DIFFUSIVE MIXING OF ORGANIC SOLUTIONS   Acronym:DMOS

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.0	RUN EXPERIMENTAL PROCESS RUN INTEGRITY TEST PROGRAM	2.00000	2.00000	0.07000	0.07000	0.00000	N	-0-
YE		112.000	112.000	0.00233	0.00233	0.00000		
4.1	INPUT PROCESSING PARAMETERS	5.00000	5.00000	0.07000	0.07000	0.50000	N	-0-
YE		117.000	117.000	0.00583	0.00583	150.000		
4.2	RUN HEAT UP PHASE	15.0000	15.0000	0.10000	0.03000	0.50000	N	-0-
YE		132.000	132.000	0.02500	0.00750	450.000		
4.3	RUN FACILITY TO HEAT UP TO DESIRE TEMPERATURE	40.0000	40.0000	0.10000	0.03000	0.50000	N	-0-
YE		172.000	172.000	0.06667	0.02000	1200.00		
4.4	RUN FACILITY TO MAINTAIN SET TEMPERATURE UNTIL PROCESS IS COMPLETE	10080.0	-0-	0.10000	0.03000	0.50000	N	MIXING OF THE ORGANIC SOLUTIONS TAKE PLACE
YE		10252.0	172.000	16.8000	5.04000	302400.		
4.5	END PROCESS RUN, ALLOW SYSTEM TO COOL	60.0000	-0-	0.07000	0.23000	0.50000	N	-0-
YE		10312.0	172.000	0.07000	0.23000	1800.00		
4.6	REMOVE EAC FROM MIDDECK LOCKER	30.0000	30.0000	0.00000	0.00000	0.00000	N	-0-
YE		10342.0	202.000	0.00000	0.00000	0.00000		

Facility:DIFFUSIVE MIXING OF ORGANIC SOLUTIONS   Acronym:DMOS

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.7	STORE EAC FOR RETURN TO THE GROUND	30.0000	30.0000	0.00000	0.00000	0.00000	N	-0-
YE		10372.0	232.000	0.00000	0.00000	0.00000		
	TOTALS	Run Time 10372.0	Crew Time 232.000	Eng. In 16.9777	Eng. Out 5.31150	Data 0.00000		

Facility:Electroeptiaxial Crystal Growth Acronym:ECG

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	Ground based activities.	-0-	-0-	0.00000	0.00000	0.00000	0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	Initial Setup	-0-	-0-	0.00000	0.00000	0.00000	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.1	Transport Facility from resupply module and interface to carrier location.	120.000	120.000	0.00000	0.00000	0.00000	-0	-0-
NO		120.000	120.000	0.00000	0.00000	0.00000		
2.2	Secure Facility in place for operation.	30.0000	30.0000	0.00000	0.00000	0.00000	-0	-0-
NO		150.000	150.000	0.00000	0.00000	0.00000		
2.3	Verify proper connections and check for leaks	10.0000	10.0000	0.00000	0.00000	0.00000	-0	-0-
NO		160.000	160.000	0.00000	0.00000	0.00000		
2.4	Review experiment procedures.	20.0000	20.0000	0.00000	0.00000	0.00000	-0	-0-
NO		180.000	180.000	0.00000	0.00000	0.00000		
3.1	Insert growth chamber and interface power leads, purge lines, and data leads.	35.0000	35.0000	0.00000	0.00000	0.00000	-0	-0-
YE		215.000	215.000	0.00000	0.00000	0.00000		

Facility:Electroeptiaxial Crystal Growth | Acronym:ECG

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
3.2	Secure the growth chamber in place.	15.0000	15.0000	0.00000	0.00000	0.00000	-0	-0-
YE		230.000	230.000	0.00000	0.00000	0.00000		
3.3	Turn on ECG mainpower switch.	2.00000	2.00000	0.02000	0.02000	2.00000	-0	-0-
YE		232.000	232.000	0.00067	0.00067	240.000		
3.4	Turn on processor controller, power conditioner, heater controller and data recorder.	2.00000	2.00000	0.12000	0.12000	2.00000	-0	-0-
YE		234.000	234.000	0.00400	0.00400	240.000		
3.5	Run system integrity test.	5.00000	1.00000	0.12000	0.12000	2.00000	-0	-0-
YE		239.000	235.000	0.01000	0.01000	600.000		
3.6	Turn on the hydrogen pruge valve and check system for leaks.	5.00000	5.00000	0.12000	0.12000	2.00000	-0	-0-
YE		244.000	240.000	0.01000	0.01000	600.000		
4.1	Run the pre-programmed growth sequence for one module.	10800.0	180.000	4.00000	4.00000	2.00000	-0	shorter run times can be used to produce smaller crystals.
YE		11044.0	420.000	720.000	720.000	.12960E7		
4.2	Turn off hydrogen purge valve.	2.00000	2.00000	0.12000	0.12000	2.00000	-0	-0-
YE		11046.0	422.000	0.00400	0.00400	240.000		

Facility:Electroeptiaxial Crystal Growth

Acronym:ECG

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.3	Turn off controller, power conditioner, and data recorder.	2.00000	2.00000	0.02000	0.02000	0.50000	-0	-0-
YE		11048.0	424.000	0.00067	0.00067	60.0000		
4.4	Turn off main power switch.	1.00000	1.00000	0.00000	0.00000	0.00000	-0	-0-
YE		11049.0	425.000	0.00000	0.00000	0.00000		
5.1	Verify growth modules at ambient temperature.	2.00000	2.00000	0.00000	0.00000	0.00000	-0	-0-
NO		11051.0	427.000	0.00000	0.00000	0.00000		
5.2	Remove processed samples and load new growth module.	35.0000	35.0000	0.00000	0.00000	0.00000	-0	-0-
NO		11086.0	462.000	0.00000	0.00000	0.00000		
5.3	Insert growth modules into shipping containers and stow.	10.0000	10.0000	0.00000	0.00000	0.00000	-0	-0-
NO		11096.0	472.000	0.00000	0.00000	0.00000		
	TOTALS	Run Time 11096.0	Crew Time 472.000	Eng. In 720.029	Eng. Out 720.029	Data 0.00000		

Facility:Electromagnetic Levitator

Acronym:EML

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	Ground based activities.	-0-	-0-	0.00000	0.00000	0.00000	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	Initial setup.	-0-	-0-	0.00000	0.00000	0.00000	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.1	Transport facility from resupply module and interface to carrier location.	120.000	120.000	0.00000	0.00000	0.00000	-0	-0-
NO		120.000	120.000	0.00000	0.00000	0.00000		
2.2	Secure facility in place for operation.	30.0000	30.0000	0.00000	0.00000	0.00000	-0	-0-
NO		150.000	150.000	0.00000	0.00000	0.00000		
2.3	Verify proper connections and check for leaks	10.0000	10.0000	0.00000	0.00000	0.00000	-0	-0-
NO		160.000	160.000	0.00000	0.00000	0.00000		
2.4	Review experiment procedures.	30.0000	30.0000	0.00000	0.00000	0.00000	-0	-0-
NO		190.000	190.000	0.00000	0.00000	0.00000		
2.5	Trun on master power switch.	2.00000	2.00000	0.06000	0.06000	0.00000	-0	-0-
NO		192.000	192.000	0.00200	0.00200	0.00000		

Facility:Electromagnetic Levitator Acronym:EML

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
2.6	Trun on data recorder.	2.00000	2.00000	0.07000	0.07000	0.00000	-0	-0-
NO		194.000	194.000	0.00233	0.00233	0.00000		
2.7	Run system integrity test.	5.00000	2.00000	0.07000	0.07000	0.00000	-0	-0-
NO		199.000	196.000	0.00583	0.00583	0.00000		
4.1	Run programmed process for first sample.	500.000	60.0000	1.20000	1.20000	0.20000	-0	-0-
YE		699.000	256.000	10.0000	10.0000	6000.00		
4.2	Repeat run for five additional samples.	2700.00	60.0000	1.20000	1.20000	0.20000	-0	-0-
YE		3399.00	316.000	54.0000	54.0000	32400.0		
5.1	Turn off master power switch.	2.00000	2.00000	0.00000	0.00000	0.00000	-0	-0-
NO		3401.00	318.000	0.00000	0.00000	0.00000		
	TOTALS	Run Time 3401.00	Crew Time 318.000	Eng. In 64.0102	Eng. Out 64.0102	Data 0.00000		

Facility:FLOAT ZONE CRYSTAL GROWTH FACILITY Acronym:FZCGF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	Ground based activities.	-0-	-0-	-0-	-0-	-0-	NA	ACTIVITIES ARE PERFORMED ON THE GROUND
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	REVIEW EXPERIMENT PROCEDURE	30.0000	30.0000	-0-	-0-	-0-	NA	-0-
NO		30.0000	30.0000	0.00000	0.00000	0.00000		
2.1	INSTALL FACILITY	-0-	-0-	-0-	-0-	-0-	NA	OBSERVE FUNDAMENTAL SAFETY PROCEDURES IN THE INSTALLATION PROCESS
NO		30.0000	30.0000	0.00000	0.00000	0.00000		
2.1.1	INSTALL UNIQUE EQUIPMENT IN FACILITY RACKS	30.0000	30.0000	-0-	-0-	-0-	NA	OBSERVE FUNDAMENTAL SAFETY PROCEDURES DURING THE INSTALLATION PROCESS
NO		60.0000	60.0000	0.00000	0.00000	0.00000		
2.1.2	INTERFACE FACILITY RACK TO LAB	30.0000	30.0000	-0-	-0-	-0-	NA	OBSERVE FUNDAMENTAL SAFETY PROCEDURES DURING THE INSTALLATION PROCESS
NO		90.0000	90.0000	0.00000	0.00000	0.00000		
3.0	PREPARE FOR EXPERIMENTAL RUN	30.0000	30.0000	-0-	-0-	-0-	NA	OBSERVE FUNDAMENTAL SAFETY PROCEDURES DURING THE PREPARATION PHASE
YE		120.000	120.000	0.00000	0.00000	0.00000		
3.1	REVIEW PROCEDURES FOR BEGINNING PROCESS OPERATION	5.00000	5.00000	-0-	-0-	-0-	NA	-0-
YE		125.000	125.000	0.00000	0.00000	0.00000		

Facility:FLOAT ZONE CRYSTAL GROWTH FACILITY   Acronym:FZCGF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
3.1.2	POWER UP PROCESSOR FACILITY	1.00000	1.00000	0.07000	0.07000	5.00000	N	-0-
YE		126.000	126.000	0.00117	0.00117	300.000		
3.1.3	RUN MASTER CONTROLLER SYSTEM TEST PROGRAM	10.0000	10.0000	0.07000	0.07000	5.00000	N	-0-
YE		136.000	136.000	0.01167	0.01167	3000.00		
4.0	BEGAN PROCESS RUN	-0-	-0-	0.07000	0.07000	5.00000	-0	-0-
YE		136.000	136.000	0.00000	0.00000	0.00000		
4.1.1	INPUT PROCESSING PARAMETER	10.0000	10.0000	0.07000	0.07000	0.50000	N	PARAMETERS NECESSARY FOR FACILITY OPERATION
YE		146.000	146.000	0.01167	0.01167	300.000		
4.1.2	INITIATE PROGRAMMED PROCESS RUN	1.00000	1.00000	0.07000	0.07000	0.50000	N	-0-
YE		147.000	147.000	0.00117	0.00117	30.0000		
4.1.3	RUN SAMPLE PROCESSING AND CONTINUE UNTIL PROCESS COMPLETED	700.000	0.00000	0.20000	0.06000	0.50000	N	OBSERVE FUNDAMENTAL SAFETY PROCEDURES DURING THIS PHASE
YE		847.000	147.000	2.33333	0.70000	21000.0		
4.1.4	TURN-OFF HEATING SYSTEM AND ALLOW SYSTEM TO COOL	30.0000	30.0000	0.07000	0.07000	0.50000	N	-0-
YE		877.000	177.000	0.03500	0.03500	900.000		

Facility:FLOAT ZONE CRYSTAL GROWTH FACILITY Acronym:FZCGF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.1.5	COMPLETE PROCESS RUN	30.0000	15.0000	0.07000	0.07000	0.50000	N	-0-
YE		907.000	192.000	0.03500	0.03500	900.000		
4.1.6	ALLOW MODULE TO COOL	60.0000	10.0000	0.07000	0.21000	0.00000	N	-0-
YE		967.000	202.000	0.07000	0.21000	0.00000		
5.0	INSERT EXPERIMENT MODULE INTO STOWAGE AREA FOR RETURN TO GROUND	15.0000	15.0000	0.00000	0.00000	0.00000	N	-0-
NO		982.000	217.000	0.00000	0.00000	0.00000		
	TOTALS	Run Time 982.000	Crew Time 217.000	Eng. In 2.49900	Eng. Out 1.00567	Data 0.00000		

Facility:FLUID EXPERIMENT SYSTEM Acronym:FES

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	Ground based activities.	-0-	-0-	-0-	-0-	-0-	N	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	INITIAL SETUP	-0-	-0-	-0-	-0-	-0-	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.01	TRANSPORT FACILITY FROM RESUPPLY MODULE AND INTERFACE TO CARRIER LOCATION	120.000	120.000	-0-	-0-	-0-	-0	-0-
NO		120.000	120.000	0.00000	0.00000	0.00000		
2.02	SECURE FACILITY IN PLACE FOR OPERATION	30.0000	30.0000	-0-	-0-	-0-	-0	-0-
NO		150.000	150.000	0.00000	0.00000	0.00000		
2.03	VERIFY PROPER CONNECTIONS AND CHECK FOR LEAKS	10.0000	10.0000	-0-	-0-	-0-	-0	-0-
NO		160.000	160.000	0.00000	0.00000	0.00000		
2.04	REVIEW EXPERIMENT PROCEDURE	30.0000	30.0000	-0-	-0-	-0-	-0	-0-
NO		190.000	190.000	0.00000	0.00000	0.00000		
2.05	TURN ON FES TO STANDBY MODE BY ACTIVATING THE PROPER EPSP SWITCHES	2.00000	2.00000	0.12100	0.39400	20.0000	N	-0-
NO		192.000	192.000	0.00403	0.01313	2400.00		

Facility:FLUID EXPERIMENT SYSTEM Acronym:FES

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
2.06	DISENGAGE LAUNCH LOCKS	10.0000	10.0000	-0-	-0-	-0-	-0	-0-
NO		202.000	202.000	0.00000	0.00000	0.00000		
2.07	TURN ON OPTICAL BENCH WARMUP	1.00000	1.00000	1.45700	1.30500	20.0000		CONCURRENT WITH STEP 4.3
NO		203.000	203.000	0.02428	0.02175	1200.00		
2.08	ADJUST OPTICAL COMPONENTS	45.0000	45.0000	1.45700	1.30500	20.0000		CONCURRENT WITH STEP 4.3
NO		248.000	248.000	1.09275	0.97875	54000.0		
2.09	REMOVE OPTICAL CALIBRATION CELL FROM STORAGE AND INSTALL ON OPTICAL BENCH	5.00000	5.00000	1.45700	1.30500	20.0000		CONCURRENT WITH STEP 4.3
NO		253.000	253.000	0.12142	0.10875	6000.00		
2.10	VERIFY THAT VACUUM HAS REACHED HOLOGRAPHIC CARTRIDGES	1.00000	1.00000	1.45700	1.30500	20.0000		CONCURRENT WITH STEP 4.3
NO		254.000	254.000	0.02428	0.02175	1200.00		
2.11	TURN ON HALOGRAPHIC CALIBRATION SEQUENCE	10.0000	10.0000	1.48400	1.48400	20.0000		-0-
NO		264.000	264.000	0.24733	0.24733	12000.0		
2.12	REMOVE CALIBRATION CELL FROM OB AND PLACE IN STORAGE	5.00000	5.00000	1.48400	1.48400	20.0000		-0-
NO		269.000	269.000	0.12367	0.12367	6000.00		

Facility:FLUID EXPERIMENT SYSTEM Acronym:FES

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
3.1	REMOVE TWO HALOGRAPHIC FILM CARTRIDGES FROM STORAGE AND TRANSFER THEM TO THE FES	15.0000	15.0000	0.12100	0.39400	20.0000		CONCURREN WITH STEP 4.3
YE		284.000	284.000	0.03025	0.09850	18000.0		
3.2	INSTALL HOLOGRAPHIC CARTRIDGES INTO THE OPTICAL BENCH	5.00000	5.00000	0.12100	0.39400	20.0000	-0	-0-
YE		289.000	289.000	0.01008	0.03283	6000.00		
3.3	REMOVE TEST CELL FROM STORAGE	7.00000	7.00000	0.12100	0.39400	20.0000	-0	-0-
YE		296.000	296.000	0.01412	0.04597	8400.00		
3.4	INSTALL TEST CELL INTO THE PREHEAT ENCLOSURE	3.00000	3.00000	0.12100	0.39400	20.0000	-0	-0-
YE		299.000	299.000	0.00605	0.01970	3600.00		
3.4.0	INSERT THE NEXT TEST CELL INTO THE PREHEAT ENCLOSURE	10.0000	10.0000	-0-	-0-	20.0000	-0	CONCURRENT WITH STEP 4.18
YE		309.000	309.000	0.00000	0.00000	12000.0		
3.5	TURN ON VACUUM HAND VALVE	1.00000	1.00000	0.12100	0.39400	20.0000	-0	-0-
YE		310.000	310.000	0.00202	0.00657	1200.00		
3.6	TURN ON THE VACUUM RESERVOIR ISOLATION VALVE	1.00000	1.00000	0.12100	0.39400	20.0000	-0	-0-
YE		311.000	311.000	0.00202	0.00657	1200.00		

Facility:FLUID EXPERIMENT SYSTEM

Acronym:FES

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.01	TURN ON HEATERS IN THE PREHEAT ENCLOSURE	3.00000	3.00000	0.66500	0.39400	20.0000	-0	-0-
YE		314.000	314.000	0.03325	0.01970	3600.00		
4.02	RUN PREHEAT CYCLE	120.000	10.0000	1.10900	0.39400	20.0000	M3	-0-
YE		434.000	324.000	2.21800	0.78800	144000.		
4.03	RUN PREHEAT HOLD	150.000	10.0000	0.88400	0.39400	20.0000	-0	PROVIDES SUFFICIENT TIME FOR OPTICAL BENCH WARMUP
YE		584.000	334.000	2.21000	0.98500	180000.		
4.04	TURN OFF PREHEAT HEATERS	1.00000	1.00000	1.30500	1.30500	20.0000	-0	-0-
YE		585.000	335.000	0.02175	0.02175	1200.00		
4.05	REMOVE TEST CELL FROM PREHEAT ENCLOSURE	10.0000	10.0000	1.30500	1.30500	20.0000	-0	SHOULD BE AUTOMATED
YE		595.000	345.000	0.21750	0.21750	12000.0		
4.06	REMOVE CELL WINDOW COVERS	2.00000	2.00000	1.30500	1.30500	20.0000	-0	-0-
YE		597.000	347.000	0.04350	0.04350	2400.00		
4.07	VIEW STING AND SOLUTION CHECKING FROM CRYSTALLITES AND BUBBLES	5.00000	5.00000	1.30500	1.30500	20.0000		-0-
YE		602.000	352.000	0.10875	0.10875	6000.00		

Facility:FLUID EXPERIMENT SYSTEM Acronym:FES

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.08	SECURE TEST CELL INTO OPTICAL BENCH LOCATION	2.00000	2.00000	1.30500	1.30500	20.0000	-0	-0-
YE		604.000	354.000	0.04350	0.04350	2400.00		
4.09	TURN OFF PREHEAT CONTROL FOR STING ASSEMBLY	1.00000	1.00000	1.30500	1.30500	20.0000	-0	-0-
YE		605.000	355.000	0.02175	0.02175	1200.00		
4.10	REMOVE PREHEAT STING UMBILICAL, ATTACH OB STING CONTROL UMBILICAL	0.50000	0.50000	1.30500	1.30500	20.0000	-0	-0-
YE		605.500	355.500	0.01088	0.01088	600.000		
4.11	TURN ON OB CELL TEMPERATURE CONTROL VIA FES OCP	0.50000	0.50000	1.30500	1.30500	20.0000	-0	-0-
YE		606.000	356.000	0.01088	0.01088	600.000		
4.12	OPERATE STING VENT VALVE	1.00000	1.00000	1.30500	1.30500	20.0000	-0	-0-
YE		607.000	357.000	0.02175	0.02175	1200.00		
4.13	ADJUST THE MECHANICAL COMPONENTS OF THE OPTICAL BENCH FROM THE SCHLIEREN USE	5.00000	5.00000	1.30500	1.30500	20.0000	-0	-0-
YE		612.000	362.000	0.10875	0.10875	6000.00		
4.14	TURN ON THE VIDEO CAMERA FOR DOWNLINK	2.00000	2.00000	1.30500	1.30500	20.0000	M3	-0-
YE		614.000	364.000	0.04350	0.04350	2400.00		

Facility:FLUID EXPERIMENT SYSTEM Acronym:FES

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.15	ADJUST THE SCHLIEREN VIA THE OCP	10.0000	10.0000	1.30500	1.30500	20.0000	M3	-0-
YE		624.000	374.000	0.21750	0.21750	12000.0		
4.16	CONTROL THE TRANSITION TO EXPERIMENT TEMPERATURE	24.0000	10.0000	1.42800	3.32800	20.0000	M3	-0-
YE		648.000	384.000	0.57120	1.33120	28800.0		
4.17	CONTROL THE EQUILIBRATION PROCESS WITH THE STIRRER	24.0000	10.0000	0.72700	0.72700	20.0000	M3	-0-
YE		672.000	394.000	0.29080	0.29080	28800.0		
4.18	CONTROL EQUILIBRATION WITHOUT STIRRER	6.00000	6.00000	0.71700	0.71700	20.0000	M3	-0-
YE		678.000	400.000	0.07170	0.07170	7200.00		
4.19	CONTROL THE CAP RETRACTION OPERATION AND ADJUST SCHLIEREN AS NECESSARY	15.0000	15.0000	0.71700	0.71700	20.0000	M3	THIS IS THE MOST CRITICAL PHASE AS FAR AS PRESERVING CRYSTAL QUALITY
YE		693.000	415.000	0.17925	0.17925	18000.0		
4.20	OPERATE THE OCP AND SCHLIEREN DURING THE TRANSITION TO GROWTH TEMPERATURE	240.000	160.000	0.71700	0.71700	20.0000	M3	-0-
YE		933.000	575.000	2.86800	2.86800	288000.		
4.21	TURN OFF STING VENT SOLENOID VALVE	1.00000	1.00000	0.71700	0.71700	20.0000	M3	-0-
YE		934.000	576.000	0.01195	0.01195	1200.00		

Facility:FLUID EXPERIMENT SYSTEM Acronym:FES

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.22	TURN OFF THE VACUUM RESERVOIR ISOLATION VALVE TO THE CLOSED POSITION	1.00000	1.00000	0.71700	0.71700	20.0000	M3	-0-
YE		935.000	577.000	0.01195	0.01195	1200.00		
4.23	OPERATE THE OCP DURING THE TEMPERATURE STABILIZATION PROCESS	60.0000	20.0000	0.66500	0.66500	20.0000	M3	-0-
YE		995.000	597.000	0.66500	0.66500	72000.0		
4.24	VIEW CRYSTAL GROWTH AND ADJUST AS NECESSARY	2880.00	250.000	0.66500	0.66500	20.0000	M3	-0-
YE		3875.00	847.000	31.9200	31.9200	.34560E7		
4.25	OPERATE THE OCP DURING CAP REPLACEMENT	10.0000	10.0000	0.66500	0.66500	20.0000	M3	-0-
YE		3885.00	857.000	0.11083	0.11083	12000.0		
4.26	TURN OFF VIDEO SWITCH	2.00000	2.00000	0.66500	0.66500	20.0000		-0-
YE		3887.00	859.000	0.02217	0.02217	2400.00		
4.28	RUN ADDITIONAL TEST CELLS AS REQUIRED.	-0-	-0-	-0-	-0-	20.0000	-0	-0-
YE		3887.00	859.000	0.00000	0.00000	0.00000		
5.17	REMOVE THE TEST CELL FROM THE OB, REPLACE WINDOW COVERS, AND STOW	10.0000	10.0000	-0-	-0-	-0-	-0	-0-
NO		3897.00	869.000	0.00000	0.00000	0.00000		

Facility:FLUID EXPERIMENT SYSTEM

Acronym:FES

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
8.1	TURN OFF FES VIA OCP SWITCHES	2.00000	2.00000	-0-	-0-	20.0000	-0	-0-
NO		3899.00	871.000	0.00000	0.00000	2400.00		
	TOTALS	Run Time 3899.00	Crew Time 871.000	Eng. In 43.7564	Eng. Out 41.8708	Data 2400.00		

Facility:High Temperature Acoustic Levitator Acronym:HAL

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	Ground based activities.	-0-	-0-	0.00000	0.00000	0.00000	0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	Initial Setup	-0-	-0-	0.00000	0.00000	0.00000	0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.1	Transport Faciltiy from resupply module and interface to carrier location	120.000	120.000	0.00000	0.00000	0.00000	-0	-0-
NO		120.000	120.000	0.00000	0.00000	0.00000		
2.2	Secure faciltiy in place for operation.	30.0000	30.0000	0.00000	0.00000	0.00000	-0	-0-
NO		150.000	150.000	0.00000	0.00000	0.00000		
2.3	Verify proper connections and check for leaks.	10.0000	10.0000	0.00000	0.00000	0.00000	-0	-0-
NO		160.000	160.000	0.00000	0.00000	0.00000		
2.4	Review experiment procedures.	30.0000	30.0000	0.00000	0.00000	0.00000	-0	-0-
NO		190.000	190.000	0.00000	0.00000	0.00000		
2.5	Turn on master power switch.	2.00000	2.00000	0.06000	0.06000	2.00000	-0	-0-
NO		192.000	192.000	0.00200	0.00200	240.000		

Facility:High Temperature Acoustic Levitator Acronym:HAL

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
2.7	Turn on microprocessor.	2.00000	2.00000	0.12000	0.12000	2.00000	-0	-0-
NO		194.000	194.000	0.00400	0.00400	240.000		
2.8	Run system integrity test and verify run parameters.	5.00000	5.00000	0.12000	0.12000	2.00000	-0	-0-
NO		199.000	199.000	0.01000	0.01000	600.000		
2.9	Insert film modules into camera.	5.00000	5.00000	0.12000	0.12000	2.00000	M4	-0-
NO		204.000	204.000	0.01000	0.01000	600.000		
3.1	Insert and secure sample cartridge.	15.0000	15.0000	0.12000	0.12000	2.00000		-0-
YE		219.000	219.000	0.03000	0.03000	1800.00		
4.1	Run Programmed process for first sample.	65.0000	15.0000	3.00000	3.00000	2.00000		-0-
YE		284.000	234.000	3.25000	3.25000	7800.00		
4.2	Run sample exchange and purge furnace.	5.00000	1.00000	0.25000	0.25000	2.00000	-0	-0-
YE		289.000	235.000	0.02083	0.02083	600.000		
4.3	Repeat steps 4.1 and 4.2 for remainder of samples	975.000	0.00000	3.00000	3.00000	2.00000	-0	longer times could produce more samples
YE		1264.00	235.000	48.7500	48.7500	117000.		

Facility:High Temperature Acoustic Levitator   Acronym:HAL

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
5.1	Turn off cameras	2.00000	2.00000	0.12000	0.12000	2.00000	-0	
NO		1266.00	237.000	0.00400	0.00400	240.000		
5.2	Remove sample cartridge and stow	-0-	-0-	-0-	-0-	-0-	-0	-0-
NO		1266.00	237.000	0.00000	0.00000	0.00000		
5.3	Turn off master power switch	2.00000	2.00000	0.00000	0.00000	0.00000	-0	-0-
NO		1268.00	239.000	0.00000	0.00000	0.00000		
	TOTALS	Run Time	Crew Time	Eng. In	Eng. Out	Data		
		1268.00	239.000	52.0808	52.0808	0.00000		

Facility:LIQUID DROP EXPERIMENT FACILITY   Acronym:LDF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	GROUND OPERATIONS	0.00000	0.00000	0.00000	0.00000	0.00000	N	GROUND BASED OPERATIONS
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.1	SERVICE THE FACILITY IN PREPARATION FOR LAUNCH.	0.00000	0.00000	0.00000	0.00000	0.00000	N	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.2	TRANSPORT THE FACILITY TO THE SHUTTLE FOR LAUNCH.	0.00000	0.00000	0.00000	0.00000	0.00000	N	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.3	INSTALL THE FACILITY INTO THE LOGISTICS ELEMENT FOR LAUNCH.	0.00000	0.00000	0.00000	0.00000	0.00000	N	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.4	SECURE THE FACILITY INTO THE LOGISTICS ELEMENT FOR LAUNCH.	0.00000	0.00000	0.00000	0.00000	0.00000	N	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.5	LAUNCH THE FACILITY.	0.00000	0.00000	0.00000	0.00000	0.00000	N	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	INSTALL THE FACILITY ON-ORBIT.	0.00000	0.00000	0.00000	0.00000	0.00000	N	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		

Facility:LIQUID DROP EXPERIMENT FACILITY   Acronym:LDF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
2.1	REMOVE THE FACILITY FROM THE LOGISTIC ELEMENT.	15.0000	15.0000	0.00000	0.00000	0.00000	N	-0-
NO		15.0000	15.0000	0.00000	0.00000	0.00000		
2.2	INSTALL THE FACILITY IN THE EXPERIMENT CARRIER.	45.0000	45.0000	0.00000	0.00000	0.00000	N	-0-
NO		60.0000	60.0000	0.00000	0.00000	0.00000		
2.3	SECURE THE FACILITY TO THE CARRIER.	15.0000	15.0000	0.00000	0.00000	0.00000	N	-0-
NO		75.0000	75.0000	0.00000	0.00000	0.00000		
2.4	VERIFY THAT THE FACILITY IS READY FOR OPERATION.	10.0000	10.0000	0.00000	0.00000	0.00000	N	-0-
NO		85.0000	85.0000	0.00000	0.00000	0.00000		
3.0	OPERATE THE PRE-RUN CHECK-OUT OF THE FACILITY.	0.00000	0.00000	0.00000	0.00000	0.00000	N	-0-
YE		85.0000	85.0000	0.00000	0.00000	0.00000		
3.1	TURN-ON THE FACILITY.	6.00000	6.00000	0.10300	0.10300	1.00000	-0	-0-
YE		91.0000	91.0000	0.01030	0.01030	360.000		
3.2	VERIFY THE FACILITY THROUGH A BIT CHECK OF THE CONTROLER.	6.00000	6.00000	0.10300	0.10300	1.00000	-0	-0-
YE		97.0000	97.0000	0.01030	0.01030	360.000		

Facility:LIQUID DROP EXPERIMENT FACILITY Acronym:LDF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
3.3	ADJUST THE VIDEO CAMERA.	1.00000	1.00000	0.10300	0.10300	1.00000	-0	-0-
YE		98.0000	98.0000	0.00172	0.00172	60.0000		
	TOTALS	Run Time 98.0000	Crew Time 98.0000	Eng. In 0.02232	Eng. Out 0.02232	Data 60.0000		

Facility:Moving Wall Electrophoresis Unit   Acronym:MWEU

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	Groung based activities.	-0-	-0-	-0-	-0-	-0-	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	Review Experiment Procedures	5.00000	5.00000	0.00000	0.00000	0.00000	0	-0-
NO		5.00000	5.00000	0.00000	0.00000	0.00000		
2.1	Verify Proper connector and fitting attachment	5.00000	5.00000	0.00000	0.00000	0.00000	0	-0-
NO		10.0000	10.0000	0.00000	0.00000	0.00000		
2.2	Turn-on electrophoresis unit.	1.00000	1.00000	0.10000	0.10000	0.10000	0	-0-
NO		11.0000	11.0000	0.00167	0.00167	6.00000		
2.3	Run system controller integrity test	5.00000	5.00000	0.10000	0.10000	0.30000	-0	-0-
NO		16.0000	16.0000	0.00833	0.00833	90.0000		
3.1	Insert sample collection unit.	5.00000	5.00000	0.00000	0.00000	0.00000	0	-0-
YE		21.0000	21.0000	0.00000	0.00000	0.00000		
3.2	Insert processing parameters	1.00000	1.00000	0.10000	0.10000	0.10000	-0	-0-
YE		22.0000	22.0000	0.00167	0.00167	6.00000		

Facility:Moving Wall Electrophoresis Unit

Acronym:MWEU

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
3.3	Engage wall rotation mechanism	1.00000	1.00000	0.32500	0.32500	0.10000	-0	-0-
YE		23.0000	23.0000	0.00542	0.00542	6.00000		
3.4	initiate buffer flow	1.00000	1.00000	0.40000	0.40000	0.10000	-0	-0-
YE		24.0000	24.0000	0.00667	0.00667	6.00000		
3.5	Verify proper buffer flow and wall rotaiton.	5.00000	5.00000	0.40000	0.40000	0.10000	-0	-0-
YE		29.0000	29.0000	0.03333	0.03333	30.0000		
3.6	Insert sample to be separated.	5.00000	5.00000	0.40000	0.40000	0.10000	-0	-0-
YE		34.0000	34.0000	0.03333	0.03333	30.0000		
4.1	Run Programmed process to completion.	360.000	15.0000	1.00000	1.00000	0.30000	-0	-0-
YE		394.000	49.0000	6.00000	6.00000	6480.00		
4.2	Repeat step 3.1 through 5.4 for additional samples.	39000.0	45.0000	1.00000	1.00000	0.30000	-0	-0-
YE		39394.0	94.0000	650.000	650.000	702000.		
5.1	Terminate buffer flow.	1.00000	1.00000	0.32500	0.32500	0.10000	-0	-0-
NO		39395.0	95.0000	0.00542	0.00542	6.00000		

Facility:Moving Wall Electrophoresis Unit Acronym:MWEU

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
5.2	Disengage wall rotation mechanism	1.00000	1.00000	1.00000	0.10000	0.10000	-0	Facility is in idle mode, remains idle concurrent with steps 2.13 to 2.15
NO		39396.0	96.0000	0.01667	0.00167	6.00000		
5.3	Remove sample collection unit.	5.00000	5.00000	-0-	-0-	-0-	-0	-0-
NO		39401.0	101.000	0.00000	0.00000	0.00000		
5.4	Insert sample in storage faciltiy.	5.00000	5.00000	-0-	-0-	-0-	-0	-0-
NO		39406.0	106.000	0.00000	0.00000	0.00000		
5.5	Turn off moving wall facility	1.00000	1.00000	-0-	-0-	-0-	-0	-0-
NO		39407.0	107.000	0.00000	0.00000	0.00000		
5.6	Secure faciltiy.	10.0000	10.0000	-0-	-0-	-0-	-0	-0-
NO		39417.0	117.000	0.00000	0.00000	0.00000		
	TOTALS	Run Time	Crew Time	Eng. In	Eng. Out	Data		
		39417.0	117.000	656.112	656.097	0.00000		

Facility:Multiple Experiment Processing Furnace   Acronym:MEPF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	Ground to station activities.	-0-	-0-	-0-	-0-	-0-	-0	These steps include all ground based and transportation operations.
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.1	Ground preparation of samples.	-0-	-0-	-0-	-0-	-0-	-0	
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.1.1	Ground prepartion of sample.	-0-	-0-	-0-	-0-	-0-	-0	
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.1.2	Move sample into ampoules and seal them.	120.000	-0-	-0-	-0-	-0-	-0	
NO		120.000	0.00000	0.00000	0.00000	0.00000		
1.2	Secure experiment equipmnt to facility rack.	120.000	-0-	-0-	-0-	-0-	-0	
NO		240.000	0.00000	0.00000	0.00000	0.00000		
1.2.1	Secure sample carousel and samples into shipping containers	60.0000	-0-	-0-	-0-	-0-	-0	
NO		300.000	0.00000	0.00000	0.00000	0.00000		
1.2.3	Secure containers containing carousel into logistic module.	30.0000	-0-	-0-	-0-	-0-	-0	
NO		330.000	0.00000	0.00000	0.00000	0.00000		

Facility:Multiple Experiment Processing Furnace   Acronym:MEPF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.2.5	Secure faciltiy rack to logistics module.	150.000	-0-	-0-	-0-	-0-	-0	
NO		480.000	0.00000	0.00000	0.00000	0.00000		
1.2.6	Connect all interfaces to facility rack and check for leaks.	15.0000	15.0000	0.00000	0.00000	0.00000	-0	-0-
NO		495.000	15.0000	0.00000	0.00000	0.00000		
2.1	Transport faciltity from logistics module to carrier.	120.000	-0-	-0-	-0-	-0-	-0	
NO		615.000	15.0000	0.00000	0.00000	0.00000		
2.2	Secure rack containing the facility to proper carrier location.	60.0000	60.0000	0.00000	0.00000	-0-	-0	
NO		675.000	75.0000	0.00000	0.00000	0.00000		
2.3	Connect required interfaces to facility rack.	30.0000	30.0000	-0-	-0-	-0-	-0	-0-
NO		705.000	105.000	0.00000	0.00000	0.00000		
3.0	Review experiment for preparation of run.	-0-	-0-	-0-	-0-	-0-	-0	These steps will be accomplished prior to each and every run.
YE		705.000	105.000	0.00000	0.00000	0.00000		
3.1	Review experiment.	10.0000	10.0000	-0-	-0-	-0-	-0	
YE		715.000	115.000	0.00000	0.00000	0.00000		

Facility:Multiple Experiment Processing Furnace Acronym:MEPF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
3.1.1	Review experimental procedures.	20.0000	20.0000	0.00000	0.00000	-0-	-0	
YE		735.000	135.000	0.00000	0.00000	0.00000		
3.1.2	attach sample carousel to furnace	15.0000	15.0000	0.00000	0.00000	-0-	-0	
YE		750.000	150.000	0.00000	0.00000	0.00000		
3.1.3	Secure furnace.	-0-	-0-	0.00000	0.00000	-0-	-0	
YE		750.000	150.000	0.00000	0.00000	0.00000		
3.2	Run system integrity test.	1.00000	5.00000	-0-	-0-	-0-	-0	
YE		751.000	155.000	0.00000	0.00000	0.00000		
3.2.1	Secure all connections and seals.	10.0000	10.0000	0.00000	0.00000	-0-	-0	
YE		761.000	165.000	0.00000	0.00000	0.00000		
3.2.2	Turn-on processor facility.	1.00000	1.00000	0.35000	0.35000	-0-	-0	Processor = 350 W
YE		762.000	166.000	0.00583	0.00583	0.00000		
3.2.3	Turn-on master controller system test program.	2.00000	2.00000	0.35000	0.35000	-0-	-0	SEE 3.2.2
YE		764.000	168.000	0.01167	0.01167	0.00000		

Facility:Multiple Experiment Processing Furnace Acronym:MEPF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.0	Run.	-0-	-0-	-0-	-0-	-0-	-0	These steps include the actual running of the facility.
YE		764.000	168.000	0.00000	0.00000	0.00000		
4.1	Run process.	-0-	-0-	-0-	-0-	-0-	-0	
YE		764.000	168.000	0.00000	0.00000	0.00000		
4.1.1	Adjust processing parameters.	10.0000	10.0000	0.35000	0.35000	1.00000	-0	SEE 3.2.2
YE		774.000	178.000	0.05833	0.05833	600.000		
4.1.2	Run furnace and sample heat-up.	180.000	15.0000	1.10000	0.60000	1.00000	-0	Peak heat rejection is 2500 W increasing from 350 W at 52.44 W/min
YE		954.000	193.000	3.30000	1.80000	10800.0		
4.1.3	Run process to sample soak	120.000	10.0000	0.60000	0.60000	1.00000	-0	-0-
YE		1074.00	203.000	1.20000	1.20000	7200.00		
4.1.4	Run process to grow crystal.	13500.0	20.0000	0.60000	0.60000	1.00000	-0	Power equal heat loss plus SEE 3.2.2
YE		14574.0	223.000	135.000	135.000	810000.		
4.1.5	Turn-off furnace and quench sample with gaseous helium for 3 seconds	0.05000	0.00000	0.35000	4.92000	1.00000		-0-
YE		14574.0	223.000	0.00029	0.00410	3.00000		

Facility:Multiple Experiment Processing Furnace   Acronym:MEPF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.1.6	Allow furnace to cool-down.	184.000	15.0000	0.60000	0.60000	1.00000	-0	Heat rejection start at 2500 W decreasing to 350 W at end of period
YE		14758.0	238.000	1.84000	1.84000	11040.0		
4.2	Run end.	-0-	-0-	-0-	-0-	-0-	-0	
YE		14758.0	238.000	0.00000	0.00000	0.00000		
4.2.1	Disassemble furnace as required to remove module.	120.000	120.000	0.35000	0.35000	-0-	-0	SEE 3.2.2
YE		14878.0	358.000	0.70000	0.70000	0.00000		
4.2.2	Move ampoules from heater module to glovebox.	20.0000	20.0000	0.35000	0.35000	-0-	-0	SEE 3.2.2
YE		14898.0	378.000	0.11667	0.11667	0.00000		
4.2.3	Turn-off controller.	1.00000	1.00000	0.00000	0.00000	-0-	-0	
YE		14899.0	379.000	0.00000	0.00000	0.00000		
5.0	Remove sample carousel from furnace	5.00000	5.00000	0.00000	0.00000	0.00000	0	-0-
NO		14904.0	384.000	0.00000	0.00000	0.00000		
5.1	Remove samples from sample carousel	5.00000	5.00000	0.00000	0.00000	0.00000	0	-0-
NO		14909.0	389.000	0.00000	0.00000	0.00000		

Facility:Multiple Experiment Processing Furnace Acronym:MEPF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
5.2	Package ampoules in shock resistant containers for return to earth.	20.0000	20.0000	0.00000	0.00000	0.00000	0	-0-
NO		14929.0	409.000	0.00000	0.00000	0.00000		
5.3	Secure and store sample carousel for safe return to earth.	10.0000	10.0000	0.00000	0.00000	0.00000	0	-0-
NO		14939.0	419.000	0.00000	0.00000	0.00000		
6.0	Run characterization.	-0-	-0-	-0-	-0-	-0-	-0	These steps will be performed during the IOC period
NO		14939.0	419.000	0.00000	0.00000	0.00000		
6.1	Review and analyze product.	-0-	-0-	-0-	-0-	-0-	-0	
NO		14939.0	419.000	0.00000	0.00000	0.00000		
6.1.01	View and photograph boule through wall of ampoule.	10.0000	10.0000	0.00000	0.00000	-0-	-0	
NO		14949.0	429.000	0.00000	0.00000	0.00000		
6.1.02	Disassemble ampoule and remove boule from ampoule.	30.0000	30.0000	0.20000	0.20000	-0-	-0	Glovebox = 200 W
NO		14979.0	459.000	0.10000	0.10000	0.00000		
6.1.03	Operate etching equipment to etch growth residue from product.	30.0000	30.0000	0.20000	0.20000	-0-	-0	Glovebox = 200 W
NO		15009.0	489.000	0.10000	0.10000	0.00000		

Facility:Multiple Experiment Processing Furnace Acronym:MEPF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
6.1.04	View and photograph product.	10.0000	10.0000	0.20000	0.20000	-0-	-0	SEE 5.1.3
NO		15019.0	499.000	0.03333	0.03333	0.00000		
6.1.05	Operate mass measurement device and measure mass of boule.	20.0000	20.0000	0.22000	0.22000	-0-	-0	Glovebox = 200 W; Mass measurement = 20 W
NO		15039.0	519.000	0.07333	0.07333	0.00000		
6.1.06	Operate dimensional device to measure physical dimensions of boule.	10.0000	10.0000	0.20000	0.20000	-0-	-0	SEE 5.1.3
NO		15049.0	529.000	0.03333	0.03333	0.00000		
6.1.07	Operate cutting unit to slice sample wafer from boule.	40.0000	40.0000	0.95000	0.95000	-0-	-0	Glovebox = 200 W; Cutting/Polishing = 750 W
NO		15089.0	569.000	0.63333	0.63333	0.00000		
6.1.08	View and photograph wafers.	10.0000	10.0000	0.20000	0.20000	-0-	-0	SEE 5.1.3
NO		15099.0	579.000	0.03333	0.03333	0.00000		
6.1.09	Operate polishing device to polish wafers.	40.0000	40.0000	0.95000	0.95000	-0-	-0	SEE 5.1.7
NO		15139.0	619.000	0.63333	0.63333	0.00000		
6.1.10	View and photograph wafer using microscope system.	40.0000	40.0000	0.15000	0.15000	-0-	-0	Microscope system = 150 W
NO		15179.0	659.000	0.10000	0.10000	0.00000		

Facility:Multiple Experiment Processing Furnace Acronym:MEPF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
6.1.11	Operate etching device to etch wafer.	30.0000	30.0000	0.20000	0.20000	-0-	-0	Glovebox = 200 W
NO		15209.0	689.000	0.10000	0.10000	0.00000		
6.1.12	View and photograph wafer using microscope system.	40.0000	40.0000	0.12000	0.12000	-0-	-0	SEE 5.1:10
NO		15249.0	729.000	0.08000	0.08000	0.00000		
6.1.13	Repeat 6.1:11 and 6.1:12 as required.	70.0000	70.0000	0.18000	0.18000	-0-	-0	Avg Power for steps
NO		15319.0	799.000	0.21000	0.21000	0.00000		
6.2	Verify wafer crystal structure.	-0-	-0-	-0-	-0-	-0-	-0	
NO		15319.0	799.000	0.00000	0.00000	0.00000		
6.2.1	View wafer using x-ray system (topography).	180.000	180.000	1.50000	1.50000	-0-	-0	X-ray system (topography) = 1500 W
NO		15499.0	979.000	4.50000	4.50000	0.00000		
6.2.2	Operate electrical conductivity probe to alyze wafer.	20.0000	20.0000	0.01500	0.01500	-0-	-0	Electrical conductivity probe = 15W
NO		15519.0	999.000	0.00500	0.00500	0.00000		
6.2.3	Operate Hall probe to analyze wafer.	40.0000	40.0000	0.50000	0.50000	-0-	-0	Hall probe = 500 W
NO		15559.0	1039.00	0.33333	0.33333	0.00000		

Facility:Multiple Experiment Processing Furnace Acronym:MEPF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
6.2.4	Operate FTIR to analyze wafer.	40.0000	40.0000	1.50000	1.50000	0.00000	0	-0-
NO		15599.0	1079.00	1.00000	1.00000	0.00000		
7.0	Review data.	-0-	-0-	-0-	-0-	-0-	-0	These steps will be performed for both the IOC and Growth missions.
NO		15599.0	1079.00	0.00000	0.00000	0.00000		
7.1	Secure and store products.	30.0000	30.0000	0.20000	0.20000	-0-	-0	Glovebox = 200 W plus 3.1.1
NO		15629.0	1109.00	0.10000	0.10000	0.00000		
7.2	Review post experiment data.	-0-	-0-	-0-	-0-	-0-	-0	
NO		15629.0	1109.00	0.00000	0.00000	0.00000		
7.2.1	Verify data as required.	30.0000	30.0000	0.00000	0.00000	-0-	-0	
NO		15659.0	1139.00	0.00000	0.00000	0.00000		
7.2.2	Verify correlation of experimental parameters to results.	30.0000	30.0000	0.00000	0.00000	-0-	-0	
NO		15689.0	1169.00	0.00000	0.00000	0.00000		
7.2.3	Review next run parameters.	60.0000	60.0000	0.00000	0.00000	-0-	-0	
NO		15749.0	1229.00	0.00000	0.00000	0.00000		

Facility:Multiple Experiment Processing Furnace Acronym:MEPF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
8.0	Clean equipment.	-0-	-0-	-0-	-0-	-0-	-0	These steps will be performed at the end of the 90 day mission or when needed.
NO		15749.0	1229.00	0.00000	0.00000	0.00000		
8.1	Clean equipment as needed.	30.0000	30.0000	0.00000	0.00000	-0-	-0	
NO		15779.0	1259.00	0.00000	0.00000	0.00000		
8.2	Secure equipment as needed.	90.0000	90.0000	0.00000	0.00000	-0-	-0	
NO		15869.0	1349.00	0.00000	0.00000	0.00000		
	TOTALS	Run Time	Crew Time	Eng. In	Eng. Out	Data		
		15869.0	1349.00	150.301	148.805	0.00000		

Facility:Normal Freezing Furnace-1 Acronym:NFF-1

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	Ground to station activities.	-0-	-0-	-0-	-0-	-0-	-0	These steps include all ground based and transportation operations.
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.1	Ground preparation of samples.	-0-	-0-	-0-	-0-	-0-	-0	
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.1.1	Ground prepartion of sample.	-0-	-0-	-0-	-0-	-0-	-0	
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
1.1.2	Move sample into ampoules and seal them.	120.000	0.00000	-0-	-0-	-0-	-0	
NO		120.000	0.00000	0.00000	0.00000	0.00000		
1.2	Insert samples into furnace modules.	30.0000	-0-	-0-	-0-	-0-	-0	
NO		150.000	0.00000	0.00000	0.00000	0.00000		
1.2.1	Secure samples into shipping containers.	20.0000	-0-	-0-	-0-	-0-	-0	
NO		170.000	0.00000	0.00000	0.00000	0.00000		
1.2.2	Secure facility to experiment rack.	60.0000	-0-	-0-	-0-	-0-	-0	
NO		230.000	0.00000	0.00000	0.00000	0.00000		

Facility:Normal Freezing Furnace-1 Acronym:NFF-1

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.2.3	Transport experiment rack, containing equipment, to logistics module	-0-	-0-	-0-	-0-	-0-	-0	
NO		230.000	0.00000	0.00000	0.00000	0.00000		
1.2.4	Secure experiment rack, containing equipment, to logistics module.	60.0000	0.00000	-0-	-0-	-0-	-0	
NO		290.000	0.00000	0.00000	0.00000	0.00000		
1.2.5	Secure samples and facility at Space Station.	-0-	-0-	-0-	-0-	-0-	-0	
NO		290.000	0.00000	0.00000	0.00000	0.00000		
1.2.6	Transport logistics module to carrier.	-0-	-0-	-0-	-0-	-0-	-0	
NO		290.000	0.00000	0.00000	0.00000	0.00000		
2.1	Transport facility rack from logistics module to carrier	60.0000	60.0000	-0-	-0-	-0-	-0	
NO		350.000	60.0000	0.00000	0.00000	0.00000		
2.1.1	Secure facility rack to carrier in assigned location for mission	60.0000	60.0000	0.00000	0.00000	-0-	-0	
NO		410.000	120.000	0.00000	0.00000	0.00000		
2.1.2	Secure facility rack to lab.	-0-	-0-	0.00000	0.00000	-0-	-0	
NO		410.000	120.000	0.00000	0.00000	0.00000		

Facility:Normal Freezing Furnace-1 Acronym:NFF-1

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
2.2.1	Connect required interaces to rack.	30.0000	30.0000	-0-	-0-	-0-	-0	These steps will be acomplished prior to each and every run.
NO		440.000	150.000	0.00000	0.00000	0.00000		
3.1	Review experiment.	-0-	-0-	-0-	-0-	-0-	-0	
YE		440.000	150.000	0.00000	0.00000	0.00000		
3.1.1	Review experimental procedures.	10.0000	10.0000	0.00000	0.00000	-0-	-0	
YE		450.000	160.000	0.00000	0.00000	0.00000		
3.1.2	Move sample into the furnace.	-0-	-0-	0.00000	0.00000	-0-	-0	
YE		450.000	160.000	0.00000	0.00000	0.00000		
3.1.3	Secure furnace.	-0-	-0-	0.00000	0.00000	-0-	-0	
YE		450.000	160.000	0.00000	0.00000	0.00000		
3.2.1	Secure all connections and seals.	10.0000	10.0000	0.00000	0.00000	-0-	-0	
YE		460.000	170.000	0.00000	0.00000	0.00000		
3.2.2	Turn-on processor controller, power conditioner, heater controller and data recorder.	1.00000	1.00000	0.35000	0.35000	-0-	-0	Processor = 350 W
YE		461.000	171.000	0.00583	0.00583	0.00000		

Facility:Normal Freezing Furnace-1 Acronym:NFF-1

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
3.2.3	Turn-on master controller system.	2.00000	2.00000	0.35000	0.35000	-0-	-0	SEE 3.2.2
YE		463.000	173.000	0.01167	0.01167	0.00000		
3.2.4	Run system integrity test.	5.00000	1.00000	-0-	-0-	-0-	-0	
YE		468.000	174.000	0.00000	0.00000	0.00000		
4.0	Run.	-0-	-0-	-0-	-0-	-0-	-0	These steps include the actual running of the facility.
YE		468.000	174.000	0.00000	0.00000	0.00000		
4.1	Run process.	-0-	-0-	-0-	-0-	-0-	-0	
YE		468.000	174.000	0.00000	0.00000	0.00000		
4.1.1	Adjust processing parameters.	10.0000	10.0000	0.35000	0.35000	-0-	-0	SEE 3.2.2
YE		478.000	184.000	0.05833	0.05833	0.00000		
4.1.2	Run furnace and sample heat-up.	90.0000	2.00000	1.00000	0.35000	8.00000	-0	Peak heat rejection is 2500 W increasing from 350 W at 52.44 W/min
YE		568.000	186.000	1.50000	0.52500	43200.0		
4.1.3	Run process to sample soak	1440.00	60.0000	0.85000	0.85000	8.00000	-0	-0-
YE		2008.00	246.000	20.4000	20.4000	691200.		

Facility:Normal Freezing Furnace-1 Acronym:NFF-1

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.1.4	Run process to grow crystal.	7920.00	660.000	0.85000	0.85000	8.00000	-0	Power equal heat loss plus SEE 3.2.2
YE		9928.00	906.000	112.200	112.200	.38016E7		
4.1.5	Turn-off furnace and allow it to cool-down.	150.000	12.0000	0.35000	0.80000	8.00000	-0	Heat rejection start at 2500 W decreasing to 350 W at end of period
YE		10078.0	918.000	0.87500	2.00000	72000.0		
4.2	Run end.	-0-	-0-	-0-	-0-	-0-	-0	
YE		10078.0	918.000	0.00000	0.00000	0.00000		
4.2.1	Disassemble furnace as required to remove module.	120.000	120.000	0.35000	0.35000	-0-	-0	SEE 3.2.2
YE		10198.0	1038.00	0.70000	0.70000	0.00000		
4.2.2	Move ampoules from heater module to glovebox.	20.0000	20.0000	0.35000	0.35000	-0-	-0	SEE 3.2.2
YE		10218.0	1058.00	0.11667	0.11667	0.00000		
4.2.3	Turn-off controller.	1.00000	1.00000	0.00000	0.00000	-0-	-0	
YE		10219.0	1059.00	0.00000	0.00000	0.00000		
5.0	Package ampoules in shock resistant containers for return to earth.	30.0000	30.0000	-0-	-0-	-0-	-0	These steps will be deleted from the IOC mission analysis.
NO		10249.0	1089.00	0.00000	0.00000	0.00000		

Facility:Normal Freezing Furnace-1 Acronym:NFF-1

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
5.1	Remove ampoule from furnace module and translation device.	10.0000	10.0000	0.00000	0.00000	0.00000	0	-0-
NO		10259.0	1099.00	0.00000	0.00000	0.00000		
6.0	Run characterization.	-0-	-0-	-0-	-0-	-0-	-0	These steps will be performed during the IOC period
NO		10259.0	1099.00	0.00000	0.00000	0.00000		
6.1	Review and analyze product.	-0-	-0-	-0-	-0-	-0-	-0	
NO		10259.0	1099.00	0.00000	0.00000	0.00000		
6.1.01	View and photograph boule through wall of ampoule.	10.0000	10.0000	0.00000	0.00000	-0-	-0	
NO		10269.0	1109.00	0.00000	0.00000	0.00000		
6.1.02	Disassemble ampoule and remove boule from ampoule.	30.0000	30.0000	0.20000	0.20000	-0-	-0	Glovebox = 200 W
NO		10299.0	1139.00	0.10000	0.10000	0.00000		
6.1.03	Operate etching equipment to etch growth residue from product.	30.0000	30.0000	0.20000	0.20000	-0-	-0	Glovebox = 200 W
NO		10329.0	1169.00	0.10000	0.10000	0.00000		
6.1.04	View and photograph product.	10.0000	10.0000	0.20000	0.20000	-0-	-0	SEE 5.1.3
NO		10339.0	1179.00	0.03333	0.03333	0.00000		

Facility:Normal Freezing Furnace-1 Acronym:NFF-1

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
6.1.05	Operate mass measurement device and measure mass of boule.	20.0000	20.0000	0.22000	0.22000	-0-	-0	Glovebox = 200 W; Mass measurement = 20 W
NO		10359.0	1199.00	0.07333	0.07333	0.00000		
6.1.06	Operate dimensional device to measure physical dimensions of boule.	10.0000	10.0000	0.20000	0.20000	-0-	-0	SEE 5.1.3
NO		10369.0	1209.00	0.03333	0.03333	0.00000		
6.1.07	Operate cutting unit to slice sample wafer from boule.	40.0000	40.0000	0.95000	0.95000	-0-	-0	Glovebox = 200 W; Cutting/Polishing = 750 W
NO		10409.0	1249.00	0.63333	0.63333	0.00000		
6.1.08	View and photograph wafers.	10.0000	10.0000	0.20000	0.20000	-0-	-0	SEE 5.1.3
NO		10419.0	1259.00	0.03333	0.03333	0.00000		
6.1.09	Operate polishing device to polish wafers.	40.0000	40.0000	0.95000	0.95000	-0-	-0	SEE 5.1.7
NO		10459.0	1299.00	0.63333	0.63333	0.00000		
6.1.10	View and photograph wafer using microscope system.	40.0000	40.0000	0.15000	0.15000	-0-	-0	Microscope system = 150 W
NO		10499.0	1339.00	0.10000	0.10000	0.00000		
6.1.11	Operate etching device to etch wafer.	30.0000	30.0000	0.20000	0.20000	-0-	-0	Glovebox = 200 W
NO		10529.0	1369.00	0.10000	0.10000	0.00000		

Facility:Normal Freezing Furnace-1 Acronym:NFF-1

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
6.1.12	View and photograph wafer using microscope system.	40.0000	40.0000	0.12000	0.12000	-0-	-0	SEE 5.1:10
NO		10569.0	1409.00	0.08000	0.08000	0.00000		
6.1.13	Repeat 6.1:11 and 6.1:12 as required.	70.0000	70.0000	0.18000	0.18000	-0-	-0	Avg Power for steps
NO		10639.0	1479.00	0.21000	0.21000	0.00000		
6.2	Verify wafer crystal structure.	-0-	-0-	-0-	-0-	-0-	-0	
NO		10639.0	1479.00	0.00000	0.00000	0.00000		
6.2.1	View wafer using x-ray system (topography).	180.000	180.000	1.50000	1.50000	-0-	-0	X-ray system (topography) = 1500 W
NO		10819.0	1659.00	4.50000	4.50000	0.00000		
6.2.2	Operate electricalconductivity probe to alyze wafer.	20.0000	20.0000	0.15000	0.01500	-0-	-0	Electrical conductivity probe = 15W
NO		10839.0	1679.00	0.05000	0.00500	0.00000		
6.2.3	Operate Hall probe to analyze wafer.	40.0000	40.0000	0.50000	0.50000	-0-	-0	Hall probe = 500 W
NO		10879.0	1719.00	0.33333	0.33333	0.00000		
6.2.4	Operater FTIR to analyze wafer.	40.0000	40.0000	1.50000	1.50000	0.00000	0	-0-
NO		10919.0	1759.00	1.00000	1.00000	0.00000		

Facility:Normal Freezing Furnace-1 Acronym:NFF-1

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
7.0	Review data.	-0-	-0-	-0-	-0-	-0-	-0	These steps will be performed for both the IOC and Growth missions.
NO		10919.0	1759.00	0.00000	0.00000	0.00000		
7.1	Secure and store products.	30.0000	30.0000	0.20000	0.20000	-0-	-0	Glovebox = 200 W plus 3.1.1
NO		10949.0	1789.00	0.10000	0.10000	0.00000		
7.2	Review post experiment data.	-0-	-0-	-0-	-0-	-0-	-0	
NO		10949.0	1789.00	0.00000	0.00000	0.00000		
7.2.1	Verify data as required.	30.0000	30.0000	0.00000	0.00000	-0-	-0	
NO		10979.0	1819.00	0.00000	0.00000	0.00000		
7.2.2	Verify correlation of experimental parameters to results.	30.0000	30.0000	0.00000	0.00000	-0-	-0	
NO		11009.0	1849.00	0.00000	0.00000	0.00000		
7.2.3	Review next run parameters.	60.0000	60.0000	0.00000	0.00000	-0-	-0	
NO		11069.0	1909.00	0.00000	0.00000	0.00000		
8.0	Clean equipment.	-0-	-0-	-0-	-0-	-0-	-0	These steps will be performed at the end of the 90 day mission or when needed.
NO		11069.0	1909.00	0.00000	0.00000	0.00000		

Facility:Normal Freezing Furnace-1 Acronym:NFF-1

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
8.1	Clean equipment as needed.	30.0000	30.0000	0.00000	0.00000	-0-	-0	
NO		11099.0	1939.00	0.00000	0.00000	0.00000		
8.2	Secure equipment as needed.	90.0000	90.0000	0.00000	0.00000	-0-	-0	
NO		11189.0	2029.00	0.00000	0.00000	0.00000		
	TOTALS	Run Time	Crew Time	Eng. In	Eng. Out	Data		
		11189.0	2029.00	143.981	144.086	0.00000		

Facility:ORGANIC AND POLYMER CRYSTAL GROWTH FAC. Acronym:OPCGF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	GROUND BASED ACTIVITIES.	-0-	-0-	0.00000	0.00000	0.00000	N	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	REVIEW EXPERIMENT PROCEDURES	30.0000	30.0000	0.00000	0.00000	0.00000	N	-0-
NO		30.0000	30.0000	0.00000	0.00000	0.00000		
2.1	INSTALL UNIQUE EQUIPMENT IN FACILITY	30.0000	30.0000	0.00000	0.00000	0.00000	N	OBSERVE FUNDAMENTAL SAFETY PROCEDURES
NO		60.0000	60.0000	0.00000	0.00000	0.00000		
2.2	INTERFACE EQUIPMENT IN MID-DECK LOCKER(S)	30.0000	30.0000	0.00000	0.00000	2.00000	N	-0-
NO		90.0000	90.0000	0.00000	0.00000	3600.00		
2.3	INSERT THE EAC(S)INTO FACILITY RACKS	5.00000	5.00000	0.75000	-0-	-0-	N	-0-
NO		95.0000	95.0000	0.06250	0.00000	0.00000		
3.0	PREPARE FOR EXPERIMENT RUN(S) REVIEW STARTING PROCEDURES	10.0000	10.0000	0.00000	0.00000	0.00000	N	-0-
YE		105.000	105.000	0.00000	0.00000	0.00000		
3.1	RUN MASTER CONTROLLER SYSTEM AND INTEGRITY TEST PROGRAMS	5.00000	5.00000	0.12500	0.12500	0.00000	N	-0-
YE		110.000	110.000	0.01042	0.01042	0.00000		

Facility:ORGANIC AND POLYMER CRYSTAL GROWTH FAC. Acronym:OPCGF

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.0	BEGAN EXPERIMENT PROCESS RUN AND INTEGRITY TEST PROGRAMS	2.00000	2.00000	0.12500	0.12500	-0-	N	-0-
YE		112.000	112.000	0.00417	0.00417	0.00000		
4.1	INPUT PROCESSING PARAMETERS	5.00000	5.00000	0.12500	0.12500	0.50000	N	-0-
YE		117.000	117.000	0.01042	0.01042	150.000		
4.2	BEGAN HEAT UP PHASE	30.0000	-0-	0.20000	0.06000	0.50000	N	-0-
YE		147.000	117.000	0.10000	0.03000	900.000		
4.3	HEAT UP TO REQUIRED TEMPERATURE	40.0000	40.0000	0.40000	0.12000	0.50000	N	-0-
YE		187.000	157.000	0.26667	0.08000	1200.00		
4.4	MAINTAIN REQUIRED TEMPERATURE UNTIL PROCESS IS COMPLETED	11520.0	-0-	0.15000	0.04500	0.50000	N	-0-
YE		11707.0	157.000	28.8000	8.64000	345600.		
4.5	END PROCESS RUN, ALLOW SYSTEM TO COOL	60.0000	-0-	0.12500	0.65000	0.50000	-0	-0-
YE		11767.0	157.000	0.12500	0.65000	1800.00		
4.6	REMOVE MODULES FROM FACILITY RACK AND STOW.	30.0000	30.0000	-0-	-0-	-0-	-0	-0-
YE		11797.0	187.000	0.00000	0.00000	0.00000		
	TOTALS	Run Time 11797.0	Crew Time 187.000	Eng. In 29.3792	Eng. Out 9.42500	Data 0.00000		

Facility:PHY. VAPOR TRANSPORT OF ORGANIC SOLIDS Acronym:PVTOS

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	GROUND BASED ACTIVITIES.	-0-	-0-	-0-	-0-	-0-	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	REVIEW EXPERIMENT PROCEDURES	30.0000	30.0000	-0-	-0-	-0-	N	-0-
NO		30.0000	30.0000	0.00000	0.00000	0.00000		
2.1	INSTALL UNIQUE EQUIPMENT IN FACILITY	30.0000	30.0000	-0-	-0-	-0-	N	-0-
NO		60.0000	60.0000	0.00000	0.00000	0.00000		
2.2	INTERFACE EQUIPMENT IN MID-DECK LOCKER	30.0000	30.0000	-0-	-0-	-0-	N	-0-
NO		90.0000	90.0000	0.00000	0.00000	0.00000		
2.3	INSERT THE EAC INTO THE MID-DECK LOCKER(S)	15.0000	15.0000	-0-	-0-	-0-	N	-0-
NO		105.000	105.000	0.00000	0.00000	0.00000		
3.0	PREPARE FOR EXPERIMENT RUN/REVIEW START UP PROCEDURES	15.0000	15.0000	-0-	-0-	-0-	N	-0-
YE		120.000	120.000	0.00000	0.00000	0.00000		
3.1	RUN MASTER CONTROLLER SYSTEM AND INTEGRITY TEST PROGRAM	5.00000	5.00000	-0-	-0-	-0-	N	-0-
YE		125.000	125.000	0.00000	0.00000	0.00000		

Facility:PHY. VAPOR TRANSPORT OF ORGANIC SOLIDS   Acronym:PVTOS

Step Number	Step Description	Step Time(min)	Crew Time(min)	Power (kW)	Thermal (kW)	Data Rate (kbps)	Video Key 1	Comments
Used for this Carrier Y/N		Total Run Time(min)	Tot. Crew Time(min)	Energy In (kW Hrs.)	Ener. Out (kW Hrs)	Tot. Data Dwn.(kB)		
4.0	BEGAN EXPERIMENT PROCESS RUN	2.00000	2.00000	0.07000	0.07000	-0-	N	-0-
YE		127.000	127.000	0.00233	0.00233	0.00000		
4.1	INPUT PROCESSING PARAMETERS	5.00000	5.00000	0.07000	0.07000	0.50000	N	-0-
YE		132.000	132.000	0.00583	0.00583	150.000		
4.2	BEGAN HEAT UP PHASE	30.0000	30.0000	0.13000	0.03900	0.50000	N	-0-
YE		162.000	162.000	0.06500	0.01950	900.000		
4.3	HEAT TO DESIRED TEMPERATURE AND ALLOW TO STABILIZE	20.0000	20.0000	0.09000	0.02700	0.50000	N	-0-
YE		182.000	182.000	0.03000	0.00900	600.000		
4.4	MAINTAIN SET TEMPERATURE UNTIL PROCESS IS COMPLETED	11520.0	0.00000	0.09000	0.02700	0.50000	N	PROCESSING OF SELECTED SOLIDS TAKE PLACE DURING THIS PHASE
YE		11702.0	182.000	17.2800	5.18400	345600.		
4.5	END PROCESS RUN ALLOW SYSTEM TO COOL	60.0000	60.0000	0.07000	0.21700	0.50000	N	-0-
YE		11762.0	242.000	0.07000	0.21700	1800.00		
4.6	REMOVE EAC(S) FROM MID-DECK LOCKER(S)	30.0000	30.0000	-0-	-0-	-0-	-0	-0-
YE		11792.0	272.000	0.00000	0.00000	0.00000		

Facility:PHY. VAPOR TRANSPORT OF ORGANIC SOLIDS Acronym:PVTOS

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.7	STORE EAC(S) MODULE(S) FOR RETURN TO GROUND	-0-	-0-	0.00000	-0-	-0-	N	-0-
YE		11792.0	272.000	0.00000	0.00000	0.00000		
	TOTALS	Run Time	Crew Time	Eng. In	Eng. Out	Data		
		11792.0	272.000	17.4532	5.43767	0.00000		

Facility:Protein Crystal Growth IV   Acronym:PCG-IV

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	Ground based activities.	-0-	-0-	0.00000	0.00000	0.00000	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	Initial setup.	-0-	-0-	0.00000	0.00000	0.00000	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.1	Transport facility from resupply module and interface to carrier location.	120.000	120.000	0.00000	0.00000	0.00000	-0	-0-
NO		120.000	120.000	0.00000	0.00000	0.00000		
2.2	Secure facility in place for operation.	30.0000	30.0000	0.00000	0.00000	0.00000	-0	-0-
NO		150.000	150.000	0.00000	0.00000	0.00000		
2.3	Verify proper connections and check for leaks	10.0000	10.0000	0.00000	0.00000	0.00000	-0	-0-
NO		160.000	160.000	0.00000	0.00000	0.00000		
2.4	Review experiment procedures.	15.0000	15.0000	0.00000	0.00000	0.00000	-0	-0-
NO		175.000	175.000	0.00000	0.00000	0.00000		
2.5	Turn on PCG-IV main power switch.	1.00000	1.00000	0.08000	0.08000	10.0000	-0	-0-
NO		176.000	176.000	0.00133	0.00133	600.000		

Facility:Protein Crystal Growth IV Acronym:PCG-IV

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
2.6	Turn on master controller and run system integrity	5.00000	5.00000	0.06000	0.06000	10.0000	-0	-0-
NO		181.000	181.000	0.00500	0.00500	3000.00		
2.7	Disengage launch locks on sample preparation mechanism and trays.	5.00000	5.00000	0.06000	0.06000	-0-	-0	-0-
NO		186.000	186.000	0.00500	0.00500	0.00000		
3.1	Insert cartridges of sample solutions, salts, PH buffer solutions, etc. into the reservoir locations.	20.0000	20.0000	0.06000	0.06000	-0-	-0	-0-
YE		206.000	206.000	0.02000	0.02000	0.00000		
3.1	Insert cartridges of sample solutions, salts, PH buffer solutions, etc. into the reservoir locations.	20.0000	20.0000	0.06000	0.06000	10.0000	-0	-0-
YE		226.000	226.000	0.02000	0.02000	12000.0		
3.2	Adjust the optical system and verify proper tray coding and orientation.	15.0000	15.0000	0.06000	0.06000	10.0000	-0	-0-
YE		241.000	241.000	0.01500	0.01500	9000.00		
3.3	Trun on the Thermal control system and allow to stabilize at run temperature.	10.0000	1.00000	0.16000	0.16000	10.0000	-0	-0-
YE		251.000	242.000	0.02667	0.02667	6000.00		
4.1	Run pre-programmed sample mixing and loading.	60.0000	10.0000	0.20000	0.20000	10.0000	-0	Duration of this step is a function of the number of samples to be prepared.
YE		311.000	252.000	0.20000	0.20000	36000.0		

Facility:Protein Crystal Growth IV Acronym:PCG-IV

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.2	Turn on video for selected sample viewing.	1.00000	1.00000	0.22000	0.22000	10.0000	M1	-0-
YE		312.000	253.000	0.00367	0.00367	600.000		
4.3	Run the crystal growth sequence.	7000.00	60.0000	0.20000	0.20000	10.0000	M1	Duration is sample dependent and may be much longer for many samples.
YE		7312.00	313.000	23.3333	23.3333	.42000E7		
4.4	View and photograph selected samples.	20.0000	20.0000	0.15000	0.15000	10.0000	M1	Duration is sample dependent and may be much longer for many samples.
YE		7332.00	333.000	0.05000	0.05000	12000.0		
5.1	Remove selected samples and package for return to ground.	20.0000	20.0000	0.15000	0.15000	10.0000	-0	Duration is sample dependent and may be much longer for many samples.
NO		7352.00	353.000	0.05000	0.05000	12000.0		
6.1	Remove and transfer selected samples for on-orbit characterization if available.	30.0000	30.0000	0.15000	0.15000	10.0000	-0	X-ray may require 8 to 15 kW peak.
NO		7382.00	383.000	0.07500	0.07500	18000.0		
8.1	Remove empty reservoir cartidges and reload for additional runs.	15.0000	15.0000	0.15000	0.15000	10.0000	-0	-0-
NO		7397.00	398.000	0.03750	0.03750	9000.00		
8.2	Repeat steps as required.	-0-	-0-	-0-	-0-	-0-	M1	-0-
NO		7397.00	398.000	0.00000	0.00000	0.00000		

Facility:Protein Crystal Growth IV　　Acronym:PCG-IV

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
8.3	Turn off camera as required.	1.00000	1.00000	0.16000	0.16000	10.0000	M1	-0-
NO		7398.00	399.000	0.00267	0.00267	600.000		
8.4	Trun on auxilliary thermal control device	1.00000	1.00000	0.16000	0.16000	10.0000	M1	-0-
NO		7399.00	400.000	0.00267	0.00267	600.000		
8.5	Trun off thermal control unit.	1.00000	1.00000	0.06000	0.06000	10.0000	M1	-0-
NO		7400.00	401.000	0.00100	0.00100	600.000		
8.6	Trun off master power switch..	1.00000	1.00000	-0-	-0-	-0-	-0	-0-
NO		7401.00	402.000	0.00000	0.00000	0.00000		
	TOTALS	Run Time 7401.00	Crew Time 402.000	Eng. In 23.8488	Eng. Out 23.8488	Data 0.00000		

Facility:THREE-AXIS ACOUSTIC LEVITATION Acronym:3AAL

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	Ground based operations.	-0-	-0-	-0-	-0-	-0-	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	INITIAL SETUP	-0-	-0-	-0-	-0-	-0-	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.1	TRANSPORT FACILITY FROM RESUPPLY MODULE AND INTERFACE TO CARRIER LOCATION	120.000	120.000	-0-	-0-	-0-	-0	-0-
NO		120.000	120.000	0.00000	0.00000	0.00000		
2.2	SECURE FACILITY IN PLACE FOR OPERATION	30.0000	30.0000	-0-	-0-	-0-	-0	-0-
NO		150.000	150.000	0.00000	0.00000	0.00000		
2.3	VERIFY PROPER CONNECTIONS AND CHECK FOR LEAKS	10.0000	10.0000	-0-	-0-	-0-	-0	-0-
NO		160.000	160.000	0.00000	0.00000	0.00000		
2.4	REVIEW EXPERIMENT PROCEDURE	30.0000	30.0000	-0-	-0-	-0-	-0	-0-
NO		190.000	190.000	0.00000	0.00000	0.00000		
3.1	TURN ON HEATER POWER	2.00000	2.00000	0.14000	0.00000	0.50000	N	-0-
YE		192.000	192.000	0.00467	0.00000	60.0000		

Facility:THREE-AXIS ACOUSTIC LEVITATION Acronym:3AAL

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
3.2	TURN ON 3AAL MAIN POWER	2.00000	2.00000	0.28000	0.28000	0.50000	N	-0-
YE		194.000	194.000	0.00933	0.00933	60.0000		
3.3	TURN ON DATA RECORDERS	1.00000	1.00000	0.00000	0.00000	0.50000	-0	-0-
YE		195.000	195.000	0.00000	0.00000	30.0000		
4.1	RUN SYSTEM THERMAL CONTROL TO OBTAIN STEADY STATE TEMPERATURE	10.0000	-0-	0.14000	0.07000	0.50000	N	-0-
YE		205.000	195.000	0.02333	0.01167	300.000		
4.2	RUN EXPERIMENT PROCESS	253.000	0.00000	0.28000	0.28000	0.50000	N	-0-
YE		458.000	195.000	1.18067	1.18067	7590.00		
5.0	TURN OFF FACILITY POWER SUPPLY MAIN SWITCH	2.00000	2.00000	0.00000	0.00000	0.50000	N	-0-
NO		460.000	197.000	0.00000	0.00000	60.0000		
	TOTALS	Run Time 460.000	Crew Time 197.000	Eng. In 1.21800	Eng. Out 1.20167	Data 60.0000		

Facility:Vapor Crystal Growth System Acronym:VCGS

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
1.0	Ground based activities.	0.00000	0.00000	0.00000	0.00000	0.00000	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.0	Initial setup	0.00000	0.00000	0.00000	0.00000	0.00000	-0	-0-
NO		0.00000	0.00000	0.00000	0.00000	0.00000		
2.1	Transport facility from resupply module and interface to carrier location	120.000	120.000	0.00000	0.00000	0.00000	-0	-0-
NO		120.000	120.000	0.00000	0.00000	0.00000		
2.2	Secure facility in place for operation.	30.0000	30.0000	0.00000	0.00000	0.00000	-0	-0-
NO		150.000	150.000	0.00000	0.00000	0.00000		
2.3	Verify proper connections and check for leaks.	10.0000	10.0000	0.00000	0.00000	0.00000	-0	-0-
NO		160.000	160.000	0.00000	0.00000	0.00000		
2.4	Review experiment procedures.	30.0000	30.0000	0.00000	0.00000	0.00000	-0	-0-
NO		190.000	190.000	0.00000	0.00000	0.00000		
2.5	Turn on FES to standby for VCGS power allocation.	2.00000	2.00000	0.12100	0.00000	20.0000	2	-0-
NO		192.000	192.000	0.00403	0.00000	2400.00		

Facility:Vapor Crystal Growth System

Acronym:VCGS

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
2.6	Disengage microscope and optical bench launch/re-entry locks.	5.00000	5.00000	0.12100	0.00000	20.0000	2	-0-
NO		197.000	197.000	0.01008	0.00000	6000.00		
3.1	Remove Experiment Module from stowage.	10.0000	10.0000	0.12100	0.00000	20.0000	2	should be automated for ISF and man-tended operation.
YE		207.000	207.000	0.02017	0.00000	12000.0		
3.2	Insert the experiment module into the VCGS facility.	3.00000	3.00000	0.12100	0.00000	20.0000	-0	-0-
YE		210.000	210.000	0.00605	0.00000	3600.00		
3.3	Remove protective cover and stow.	2.00000	2.00000	0.12100	0.00000	20.0000	-0	-0-
YE		212.000	212.000	0.00403	0.00000	2400.00		
3.4	Turn on master power switch on VCGS OCP.	1.00000	1.00000	0.19600	0.19700	20.0000	-0	-0-
YE		213.000	213.000	0.00327	0.00328	1200.00		
3.5	Turn on video switch on the FES OCP and switch to VCGS position.	1.00000	1.00000	0.19600	0.06000	20.0000	M3	-0-
YE		214.000	214.000	0.00327	0.00100	1200.00		
3.6	Adjust light level/angle. Adjust microscope focus. Rotate furnace with knob and verify focus on seed crystal.	13.0000	13.0000	0.19600	0.06000	20.0000	M3	-0-
YE		227.000	227.000	0.04247	0.01300	15600.0		

Facility:Vapor Crystal Growth System Acronym:VCGS

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
3.7	Turn off video switch on FES OCP.	1.00000	1.00000	0.19600	0.06000	20.0000	-0	-0-
YE		228.000	228.000	0.00327	0.00100	1200.00		
4.01	Turn on programmed growth mode routine via FES OCP.	240.000	40.0000	0.45800	0.23300	20.0000	M3	-0-
YE		468.000	268.000	1.83200	0.93200	288000.		
4.02	Run heat up stage.	200.000	0.00000	0.45800	0.23300	20.0000	m3	4.02 and 4.03 run concurrently.
YE		668.000	268.000	1.52667	0.77667	240000.		
4.03	Verify crystal behavior and adjust temperatures as necessary.	40.0000	40.0000	0.45800	0.23300	20.0000	M3	Crew required first 5 minutes and 5 minuites every 1/2 hour.
YE		708.000	308.000	0.30533	0.15533	48000.0		
4.04	Turn on video switch on FES OCP.	8.00000	8.00000	0.45800	0.23300	20.0000	M3	Scheduled as downlink video is available.
YE		716.000	316.000	0.06107	0.03107	9600.00		
4.05	Run initialization for programmed growth mode.	5.00000	5.00000	0.31900	0.17300	20.0000	M3	-0-
YE		721.000	321.000	0.02658	0.01442	6000.00		
4.06	Adjust source temperature cycling amplitude, duration, and frequency to prevent etching.	608.000	608.000	0.31900	0.17300	20.0000	M3	Crew required 5 min every hour for 5 hours,5 min every 1/2 thereafter during 4.7
YE		1329.00	929.000	3.23253	1.75307	729600.		

Facility:Vapor Crystal Growth System Acronym:VCGS

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
4.07	Run experiment process to completion.	6999.00	0.00000	0.31900	0.14600	20.0000	M3	4.06 and 4.07 are concurrent.
YE		8328.00	929.000	37.2114	17.0309	.83988E7		
4.08	Turn on programmed cool-down via FES OCP.	1.00000	1.00000	0.28300	0.14600	20.0000	M3	-0-
YE		8329.00	930.000	0.00472	0.00243	1200.00		
4.09	Adjust parameters as needed during cool-down.	1800.00	10.0000	0.28300	0.13700	20.0000	M3	Power decreases linearly to 0.207 kW
YE		10129.0	940.000	8.49000	4.11000	.21600E7		
4.10	Turn-off growth mode via FES OCP.	1.00000	1.00000	0.00000	0.10800	0.00000	M3	-0-
YE		10130.0	941.000	0.00000	0.00180	0.00000		
4.11	Turn-off video switch on FES OCP.	1.00000	1.00000	0.00000	0.00000	0.00000	M3	-0-
YE		10131.0	942.000	0.00000	0.00000	0.00000		
4.12	Turn-off power switch on VCGS.	1.00000	1.00000	0.13200	0.00000	0.00000	M3	-0-
YE		10132.0	943.000	0.00220	0.00000	0.00000		
4.13	Turn-off power switch on FES OCP.	1.00000	1.00000	0.00000	0.00000	0.00000	M3	-0-
YE		10133.0	944.000	0.00000	0.00000	0.00000		

Facility:Vapor Crystal Growth System Acronym:VCGS

Step Number / Used for this Carrier Y/N	Step Description	Step Time(min) / Total Run Time(min)	Crew Time(min) / Tot. Crew Time(min)	Power (kW) / Energy In (kW Hrs.)	Thermal (kW) / Ener. Out (kW Hrs)	Data Rate (kbps) / Tot. Data Dwn.(kB)	Video Key 1	Comments
5.1	Insert experiment module into protective cover.	15.0000	15.0000	0.00000	0.00000	-0-	-0	-0-
NO		10148.0	959.000	0.00000	0.00000	0.00000		
5.2	Remove experiment module and stow.	10.0000	10.0000	0.00000	0.00000	-0-	-0	-0-
NO		10158.0	969.000	0.00000	0.00000	0.00000		
5.3	Secure facility and equipment drawer.	7.00000	7.00000	0.00000	0.00000	0.00000	-0	-0-
NO		10165.0	976.000	0.00000	0.00000	0.00000		
	TOTALS	Run Time 10165.0	Crew Time 976.000	Eng. In 52.7891	Eng. Out 24.8260	Data 0.00000		

Video Key 1:

XY = Resolution and Frame Rate as Defined Below

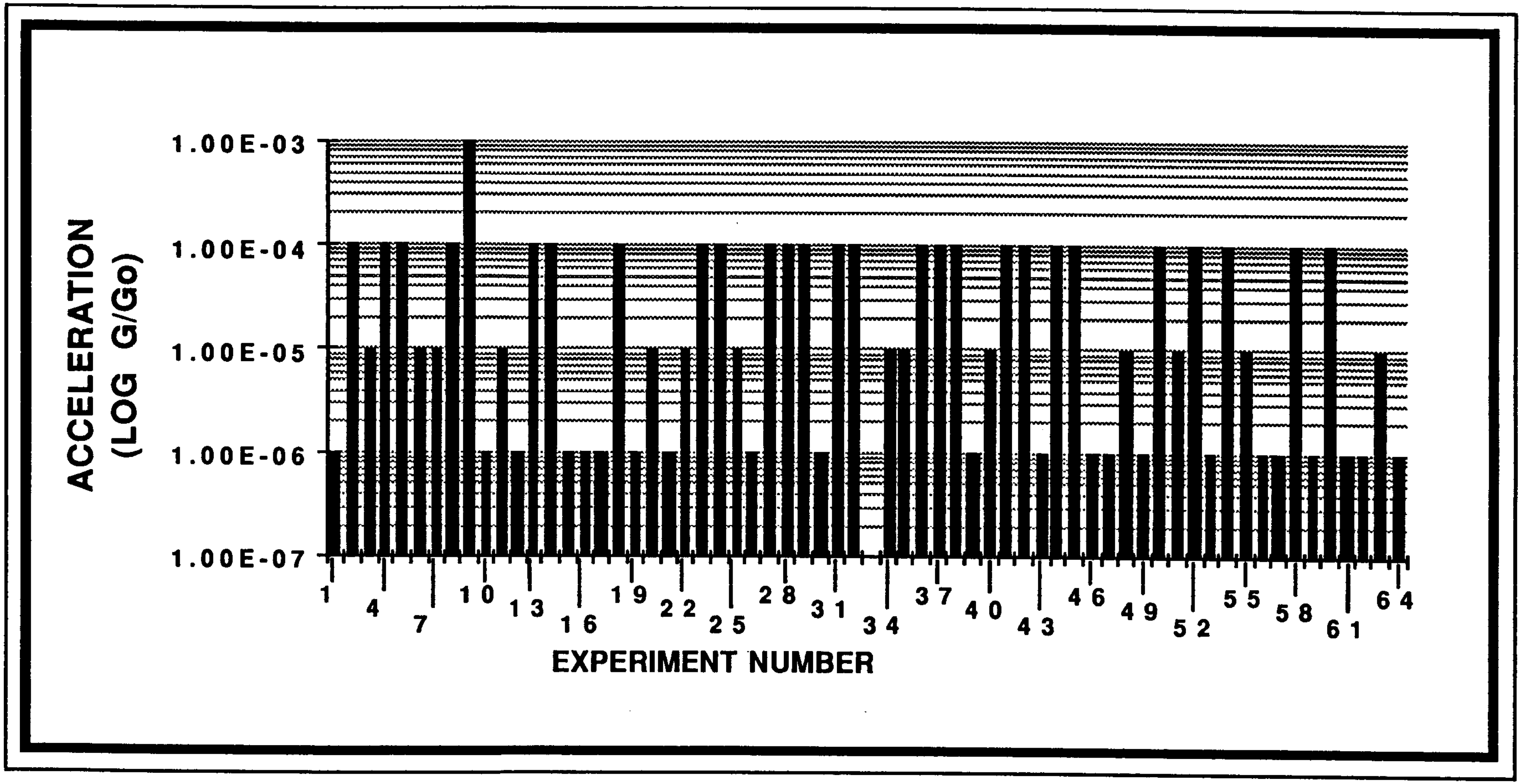
HY = High Resolution, 1000x1000 pixels or greater
MY = Medium Resolution, 300x300 to 1000x1000 pixels
LY = Low Resolution, 150x150 to 300x300 pixels

X1 = Frame Rate of 1 or less FPS
X2 = Frame Rate of 1 to 30 FPS
X3 = Frame Rate of 30 to 60 FPS
X4 = Frame Rate of 60 to 150 FPS
X5 = Frame Rate of 150 to 300 FPS
X6 = Frame Rate of 300 to 500 FPS
X7 = Frame Rate of 500 to 1000 FPS
X8 = Frame Rate of 1000 to 10+5 FPS
X9 = Frame Rate of Greater than 10+5 FPS

2.2 EXPERIMENTAL FACILITY USER REQUIREMENTS

The user requirements were developed based on the 65 experiments/facilities in the RACO data base. Requirements Synopsis Sheets were completed for each experiment/ facility. The data from each sheet were entered into a spreadsheet program and bar charts for each requirement were developed. From these bar charts a summary sheet was developed. The summary sheet, bar charts, and requirements synopsis sheets are given in the following section.

USER ACCELERATION REQUIREMENTS



| FOLDOUT FRAME

2 FOLDOUT FRAME

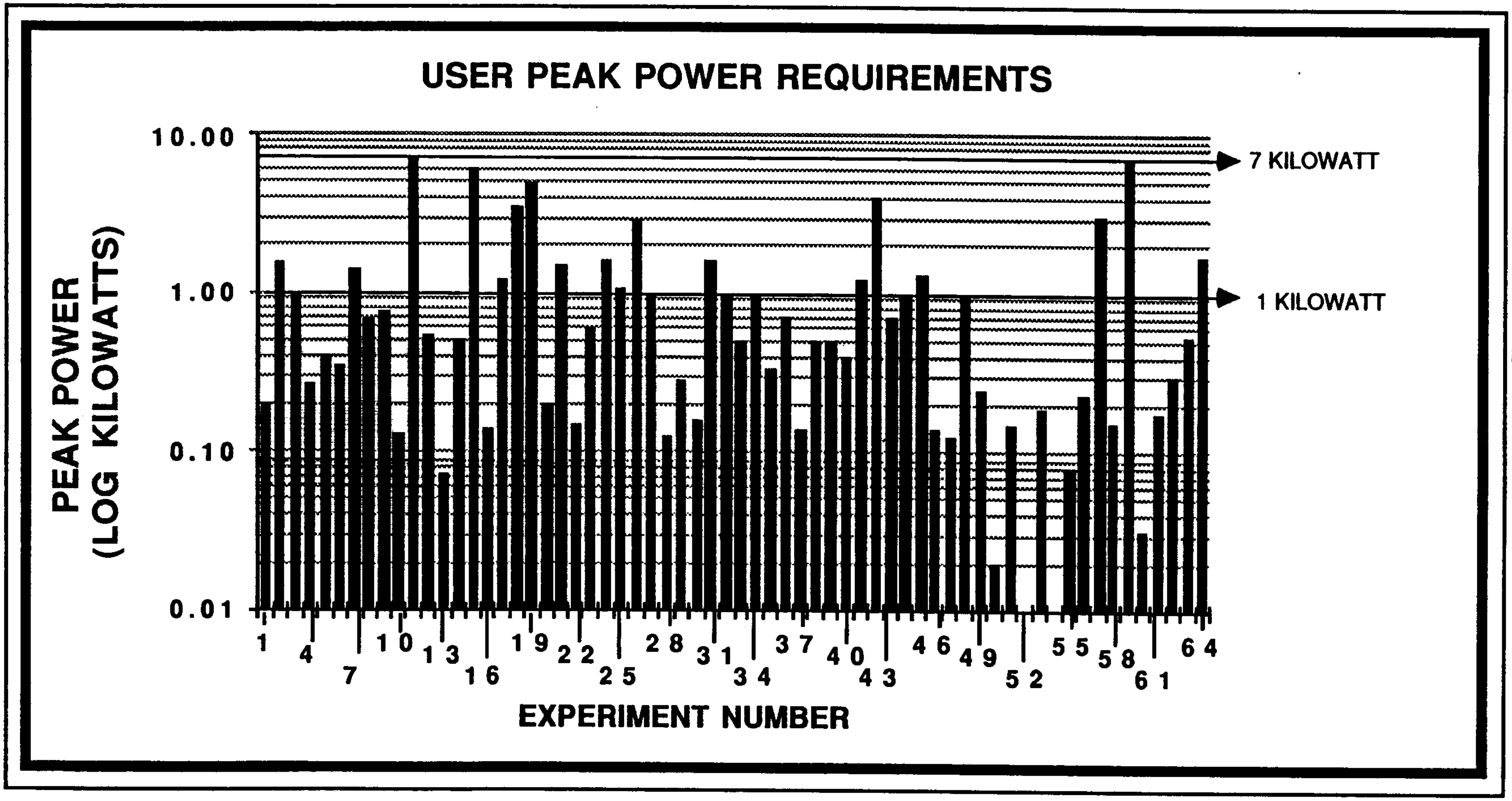
DATA WORKSHEET

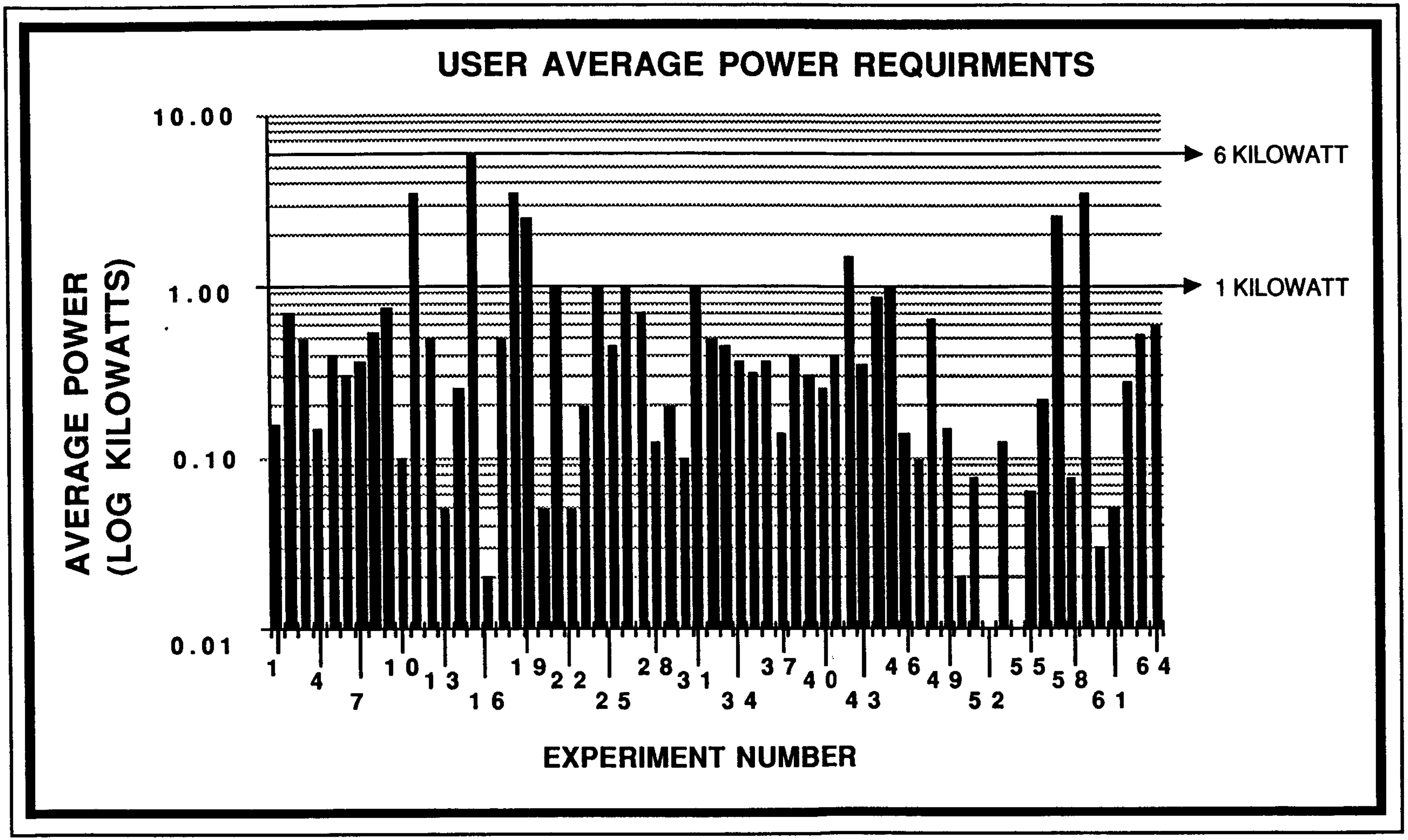
NO.	FACILITY	ACRONYM	PAYLOAD DATA: VOLUME (CU FT)	PAYLOAD DATA: MASS (LBS)	PAYLOAD DATA: RUN TIME (HRS)	DATA REQUIREMENTS: EXPERIMENT DATA RATE (BITS/SEC)	VIDEO DATA: RESOLUTION X PIXELS	VIDEO DATA: RESOLUTION Y PIXELS	VIDEO DATA: FRAMES (FPS)	VIDEO DATA: % VID. TO GROUND	VIDEO DATA (KBPS)	TOTAL DATA DOWN (KBPS)	VENTING: VOLUME (STD FT3)	VENTING: DURATION (HR)	VENTING: RATE (FT3/MIN)	VENTING: PRESSURE (TORR)	POWER/THERMAL: PEAK (kW)	POWER/THERMAL: AVERAGE (kW)	WILL IT PHYSICALLY FIT?	WILL IT RUN WITH-OUT CREW?	CONSUMABLES: MASS (lbs) TOTAL	CONSUMABLES: VOL. (ft3) TOTAL	ACCELERATION G0/G
1	ACOUSTIC CONTAINERLESS EXPERIMENT SYS.	ACES	4.5	235	2	2000	525	525	10	0	0.00	2.00	0.000	0	0.000E+00	0.00E+00	0.20	0.16	YES	YES	0.000E+00	0.000E+00	1.00E-06
2	ACOUSTIC LEVITATOR FURNACE	ALF	5.023	100.31	2.62	32	240	520	30	90	67392.00	67392.03	1.305	4.1	5.305E-03	1.00E-05	1.54	0.70	YES	NO	9.616E-01	2.267E-02	1.00E-04
3	ADVANCED AUTOMATED DIRECTIONAL SOLID. FUR.	AADSF	3.1	165	336	400	0	0	0	0	0.00	0.40	1.550	72	3.588E-04	1.00E-05	1.00	0.50	YES	YES	1.200E+01	2.100E-01	1.00E-05
4	AUTOMATED DIRECTIONAL SOLIDIFICATION FUR.	ADSF	6.04	170	336	22	0	0	0	0	0.00	0.02	5.250	72	1.215E-03	1.00E-03	0.26	0.15	YES	YES	1.200E+01	2.000E-01	1.00E-04
5	BUBBLE BEHAVIOR UNIT	BBU	3.1	40	2	32000	240	520	30	0	0.00	32.00	0.000	0	0.000E+00	0.00E+00	0.40	0.40	YES	YES	1.000E+00	2.000E-02	1.00E-04
6	CHEMICAL VAPOR TRANSPORT	CVT	41	440	72	1000	1025	1025	10	0	0.00	1.00	0.000	0	0.000E+00	0.00E+00	0.35	0.30	YES	NO	0.000E+00	0.000E+00	1.00E-05
7	CONTINUOUS HEATING FURNACE	CHF	5.87	198.42	4.28	64	0	0	0	0	0.00	0.06	5.880	72	1.361E-03	1.00E-05	1.40	0.37	YES	YES	1.956E+01	2.300E-01	1.00E-05
8	CONTINUOUS FLOW ELETROPHORESIS SYSTEM	CFES	81	1638	160	300	190	190	30	100	21660.00	21660.30	3110.000	24	2.160E+00	6.20E+02	0.68	0.55	YES	NO	1.000E+03	6.000E+01	1.00E-04
9	CRITICAL FLUID LIGHT SCATTERING SYSTEM	CFLSE	4	100	8	200	0	0	0	0	0.00	0.20	0.000	0	0.000E+00	0.00E+00	0.75	0.75	YES	YES	1.000E+00	2.000E-02	1.00E-03
10	DIFFUSIVE MIXING OF ORGANIC SOLUTIONS	DMOS	2.01	188	1200	2500	0	0	0	0	0.00	2.50	0.520	1	8.667E-03	1.00E+00	0.13	0.10	YES	YES	1.640E-01	1.060E+00	1.00E-06
11	DIRECTIONAL SOLIDIFICATION FURNACE	DSF	82	1200	672	3000	0	0	0	0	0.00	3.00	15.000	72	3.472E-03	1.00E-05	7.00	3.50	NO	YES	6.400E+01	1.550E-01	1.00E-05
12	DROP DYNAMICS MODULE	DDM	41.5	792	48	1000	1000	1000	5	1	1000.00	1001.00	0.000	0	0.000E+00	1.00E-03	0.55	0.50	YES	NO	0.000E+00	0.000E+00	1.00E-06
13	DROPLET COMBUSTION EXPERIMENT	DCE	6	152.145	1	100	1000	1000	400	20	1600000.00	1600000.10	2.000	24	1.389E-03	1.00E+00	0.07	0.05	YES	NO	2.318E+00	1.380E-02	1.00E-04
14	DROPLET TECHNOLOGY DEMONSTRATION	DTD	8	161.406	1	1000	1000	1000	400	20	1600000.00	1600001.00	20.000	24	1.389E-02	1.00E+00	0.50	0.25	YES	NO	4.305E+00	1.240E-01	1.00E-04
15	ELECTROEPITAXIAL CRYSTAL GROWTH	ECG	124.6	4103	1680	2000	0	0	0	0	0.00	2.00	3.000	1152	4.340E-05	6.00E+02	6.00	6.00	YES	YES	7.500E-05	1.500E-02	1.00E-06
16	ELECTRODEPOSITION	EDEP	7.063	132.28	960	0.38	0	0	0	0	0.00	0.00	0.000	0	0.000E+00	0.00E+00	0.14	0.02	YES	YES	6.600E+00	7.100E+00	1.00E-06
17	ELECTROMAGNETIC LEVITATOR	EML	2.1	92.4	48	500	0	0	0	0	0.00	0.50	1.000	720	2.315E-05	1.00E-07	1.20	0.50	YES*	YES	0.000E+00	0.000E+00	1.00E-06
18	ELECTROPHORETIC OPERATIONS IN SPACE	EOS	1767	24600	4320	5000	0	0	0	0	0.00	5.00	4665.000	24	3.240E+00	6.20E+02	3.50	3.50	NO	YES	2.460E+04	1.767E+03	1.00E-04
19	FLOAT ZONE CRYSTAL GROWTH FACILITY	FZCGF	6.53	295	1200	1500	0	0	0	60	0.00	1.50	1.059	24	7.354E-04	1.00E-03	5.00	2.50	YES	YES*	9.500E-02	4.944E-03	1.00E-06
20	FLUIDS EXPERIMENT APPARATUS	FEA	3	79.38	72	100	250	250	0.02	10	2.50	2.60	0.000	0	0.000E+00	0.00E+00	0.20	0.05	YES	NO	1.250E-01	2.000E-03	1.00E-05
21	FLUIDS EXPERIMENT SYSTEM	FES	41	1084.6	72	20000	625	625	30	3	7031.25	7051.25	0.001	1	1.667E-05	1.00E+00	1.48	0.98	YES*	NO	0.000E+00	0.000E+00	1.00E-06
22	GAS-JET DIFFUSION FLAMES EXPERIMENT	GDFE	4	100	1	100	1000	1000	400	20	1600000.00	1600000.10	5.000	0.016667	5.000E+00	1.00E+00	0.15	0.05	YES	NO	6.040E+00	1.402E+00	1.00E-05
23	GRADIENT FURNACE FOR THE GET-AWAY-SPECIAL	GFGAS	5	180	336	0	0	0	0	0	0.00	0.00	5.200	72	1.204E-03	1.00E-03	0.60	0.20	YES	YES	0.000E+00	0.000E+00	1.00E-04
24	GRADIENT GENERAL PURPOSE ROCKET FURNACE	G-GPRF	3	145	336	64	0	0	0	0	0.00	0.06	5.300	72	1.227E-03	1.00E-03	1.60	1.00	YES*	YES	1.350E 01	2.000E-01	1.00E-04
25	GRADIENT HEATING FURNACE	GHF	3.24	144.4	15.43	32	0	0	0	0	0.00	0.03	5.100	72	1.181E-03	1.00E-03	1.08	0.45	YES	YES	1.200E 01	2.100E-01	1.00E-05
26	HIGH TEMPERATURE ACOUSTIC LEVITATOR	HAL	41	649	96	3000	400	400	30	1	960.00	963.00	3.200	48	1.111E-03	1.00E-03	2.88	1.00	YES	YES	1.600E 02	1.600E-02	1.00E-06
27	IMAGE FURNACE	IMF	9.547	271.17	7.67	32	240	520	30	90	67392.00	67392.03	21.930	6.9	5.297E-02	1.00E-05	0.97	0.70	YES	NO	3.393E+00	1.250E-01	1.00E-04
28	INITIAL BLOOD STORAGE EXPERIMENT	IBSE	1.14	103	720	0	0	0	0	0	0.00	0.00	0.000	0	0.000E+00	0.00E+00	0.13	0.13	YES	YES	3.250E+00	5.000E-02	1.00E-04
29	ISOELECTRIC FOCUSING	IEF	2.08	76.5	1.5	0	0	0	0	0	0.00	0.00	0.000	0	0.000E+00	0.00E+00	0.28	0.20	YES	NO	1.000E+02	4.020E+00	1.00E-04
30	ISOTHERMAL DENDRITIC GROWTH EXPERIMENT	IDGE	4.02	200	168	1500	525	525	0.01667	10	9.19	10.69	0.040	18	3.704E-05	1.00E-03	0.16	0.10	YES	YES	4.000E-02	2.472E-03	1.00E-06
31	ISOTHERMAL GENERAL PURPOSE ROCKET FURNACE	I-GPRF	3	145	336	64	0	0	0	0	0.00	0.06	5.300	72	1.227E-03	1.00E-03	1.60	1.00	YES*	YES	1.350E+01	2.000E-01	1.00E-04
32	ISOTHERMAL HEATING FURNACE	IHF	41	550	336	32	0	0	0	0	0.00	0.03	6.200	72	1.435E-03	1.00E-05	1.00	0.50	YES	YES	1.400E+01	2.200E-01	1.00E-04
33	LAMBDA POINT EXPERIMENT	LPE	41	880	1680	5000	500	500	100	1	5000.00	5005.00	12345.000	2160	9.525E-02	1.00E-07	0.50	0.45	YES*	YES*	4.200E+01	2.118E+01	1.00E-07
34	LARGE ISOTHERMAL FURNACE	LIF	1.678	72.75	11.93	24	0	0	0	0	0.00	0.02	8.300	72	1.921E-03	1.00E-05	0.98	0.36	YES	YES	1.200E+01	2.100E-01	1.00E-05
35	LIQUID DROP EXPERIMENT FACILITY	LDF	4	110.25	1	3000	1000	1000	1	10	2000.00	2003.00	0.390	24	2.708E-04	1.00E+00	0.34	0.31	YES	NO	2.442E-01	3.282E-01	1.00E-05
36	LOW TEMPERATURE GRADIENT HEATING FURNACE	LTGHF	3.1	100	672	48	0	0	0	0	0.00	0.05	4.200	72	9.722E-04	1.00E-03	0.70	0.36	YES	YES	8.000E+00	1.900E-01	1.00E-04
37	MAGNETIC ISOLATION SYSEM	MIS	2.01	80	336	15	0	0	0	0	0.00	0.02	0.000	0	0.000E+00	0.00E+00	0.14	0.14	YES	YES	0.000E+00	0.000E+00	1.00E-04
38	MARANGONI CONVECTION UNIT	MCU	3.1	35	2	32000	240	520	30	100	74880.00	74912.00	0.000	0	0.000E+00	0.00E+00	0.50	0.40	YES	YES	1.000E+00	2.000E-02	1.00E-04
39	MECHANICS OF GRANULAR MATERIALS	MGM	4.02	200	168	2500	525	525	0.01667	80	73.50	76.00	0.000	0	0.000E+00	1.00E+00	0.50	0.30	YES	YES	2.000E-02	1.236E-03	1.00E-06
40	MEPHISTO	MEPHISTO	3.1	200	165	1200	0	0	0	0	0.00	1.20	0.000	0	0.000E+00	0.00E+00	0.40	0.25	YES*	YES*	1.000E-02	1.000E-02	1.00E-05
41	MIRROR HEATING FURNACE	MHF	18.8	330	336	48	0	0	0	0	0.00	0.05	7.400	72	1.713E-03	1.00E-05	1.20	0.40	YES	YES	9.000E+00	1.200E-01	1.00E-04
42	MODULAR ELECTROMAGNETIC LEVITATOR	MEL	41	770	144	16000	240	520	5	6	748.80	764.80	4.000	24	2.778E-03	1.00E-07	3.97	1.53	YES	YES*	3.200E-01	2.000E-02	1.00E-04
43	MONODISPERSE LATEX REACTOR SYSTEM	MLRS	6.03	198	80	400	240	240	0.01667	60	11.52	11.92	0.177	4	7.354E-04	1.00E-03	0.70	0.35	YES	YES*	4.000E-02	2.472E-03	1.00E-06
44	MOVING WALL ELECTROPHORESIS UNIT	MWEU	27	556	160	300	190	190	30	100	21660.00	21660.30	311.000	24	2.160E-01	6.20E+02	1.00	0.88	YES	YES*	5.560E+02	2.700E+01	1.00E-04
45	MULTIPLE EXPERIMENT PROCESSING FACILITY	MEPF	41	250	240	200	0	0	0	0	0.00	0.20	12.000	72	2.778E-03	1.00E-05	1.30	1.00	YES*	YES	1.200E+01	2.000E-01	1.00E-04
46	NON-LINEAR OPTICAL MONOMERS & THIN FILMS	NLOMTF	9.711	209.44	720	0.59	0	0	0	0	0.00	0.00	1.010	5	3.367E-03	2.50E-01	0.14	0.14	YES	YES	1.050E+01	4.800E-01	1.00E-06
47	NON-LINEAR OPTICAL ORGANIC CRYSTALS	NLOOC	7.063	119.05	720	0.59	0	0	0	0	0.00	0.00	0.000	0	0.000E+00	0.00E+00	0.13	0.10	YES	YES	6.600E+00	7.100E+00	1.00E-06
48	NORMAL FREEZING FURNACE	NFF	4	150	504	144	0	0	0	0	0.00	0.14	13.390	72	3.100E-03	1.00E-03	1.00	0.65	YES	YES	1.339E+01	2.200E-01	1.00E-05
49	ORGANIC CRYSTAL GROWTH EXPERIMENT	OCGE	17.08	1089	1200	2500	0	0	0	80	0.00	2.50	7.972	1.5	8.858E-02	1.00E+00	0.25	0.15	YES	YES	3.280E-01	2.120E+00	1.00E-06
50	ORGANIC SEPARATIONS	ORSEP	7.946	132.3	960	0.011	0	0	0	0	0.00	0.00	0.000	0	0.000E+00	0.00E+00	0.02	0.02	YES	YES	6.600E+00	7.100E+00	1.00E-04
51	PARTICLE CLOUD COMBUSTION EXPERIMENT	PCCE	8	149.94	1	1000	1000	1000	400	10	800000.00	800001.00	0.200	0.016667	2.000E-01	1.00E+00	0.15	0.08	YES	NO	3.650E+00	1.128E-01	1.00E-05
52	PHASE PARTITIONING EXPERIMENT	PPE	2	11.5	2	0	0	0	0	0	0.00	0.00	0.000	0	0.000E+00	0.00E+00	0.00	0.00	YES	YES*	4.000E+00	2.000E+00	1.00E-04
53	PHYSICAL VAPOR TRANSPORT OF ORGANIC SOLIDS	PVTOS	6.53	209	96	2500	0	0	0	0	0.00	2.50	0.530	1	8.833E-03	1.00E+00	0.19	0.13	YES	YES	1.640E-01	1.060E+00	1.00E-06
54	PROTEIN CRYSTAL GROWTH-I	PCG-I	0.14	20	24	0	0	0	0	0	0.00	0.00	0.000	0	0.000E+00	0.00E+00	0.00	0.00	YES	NO	0.000E+00	0.000E+00	1.00E-04
55	PROTEIN CRYSTAL GROWTH-II/III	PCG-II/III	0.84	40	336	0	0	0	0	0	0.00	0.00	0.000	0	0.000E+00	0.00E+00	0.08	0.06	YES	NO	0.000E+00	0.000E+00	1.00E-05
56	PROTIEN CRYSTAL GROWTH-IV	PCG-IV	41.3	550	672	100	325	325	5	10	1056.25	1056.35	14.280	48	4.958E-03	1.00E+00	0.23	0.22	YES	YES	1.100E+00	7.100E-02	1.00E-06
57	SINGLE AXIS ACOUSTIC LEVITATOR	SAAL	4	135	72	2000	240	520	1	10	249.60	251.60	0.042	10	7.000E-05	1.00E+00	3.10	2.60	YES	YES	1.600E-04	2.000E-03	1.00E-06
58	SOLID SURFACE COMBUSTION EXPERIMENT	SSCE	8	130.095	1	100	1000	1000	400	20	1600000.00	1600000.10	2.000	24	1.389E-03	1.00E+00	0.16	0.08	YES	NO	2.318E+00	1.380E-02	1.00E-04
59	SPACE ULTRA-VACUUM RESEARCH FACILITY	SURF	41.53	330	168	1000	0	0	0	80	0.00	1.00	0.177	1.5	1.962E-03	1.00E-03	7.00	3.50	YES*	YES	1.485E+00	1.766E-01	1.00E-06
60	STATIC COLUMN ELECTROPHORETIC SEPARATOR	SCES	0.25	7.5	2	0	0	0	0	0	0.00	0.00	0.000	0	0.000E+00	6.20E+02	0.03	0.03	YES	NO	7.500E+00	2.500E-01	1.00E-04
61	SURFACE TENSION DRIVEN CONVECTION EXP.	STDCE	4	110.25	48	100	200	200	1	5	40.00	40.10	0.000	0	0.000E+00	0.00E+00	0.18	0.05	YES	YES	0.000E+00	0.000E+00	1.00E-06
62	THREE AXIS ACOUSTIC LEVITATOR	3AAL	2.85	155.8	24	2000	500	500	30	1	1500.00	1502.00	0.050	5	1.667E-04	1.00E+01	0.30	0.28	YES*	YES	3.600E-03	2.500E-04	1.00E-06
63	VAPOR CRYSTAL GROWTH SYSTEM	VCGS	18.8	163.26	336	20000	500	500	1	1	50.00	70.00	0.000	0	0.000E+00	0.00E+00	0.55	0.52	YES*	YES*	0.000E+00	0.000E+00	1.00E-05
64	ZEOLITE CRYSTAL GROWTH	ZCG	18	400	1008	2000	525	525	10	1	551.25	553.25	0.000	0	0.000E+00	1.00E-03	1.70	0.60	YES	YES	0.000E+00	0.000E+00	1.00E-06
		TOTAL	2759.341	46425.15	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	26588.1406	1912.61117	....
		AVERAGE	43.1147	725.3929	381.8817	2683.16517	241.9531	268.2031	37.798	15.625	116769.81	116772.493	322.20238	84.5474	0.17392175	48.4885	1.097406	0.673047	....	....	415.439697	29.8845496	5.88E-05

* SEE DATA SHEET FOR COMMENTS

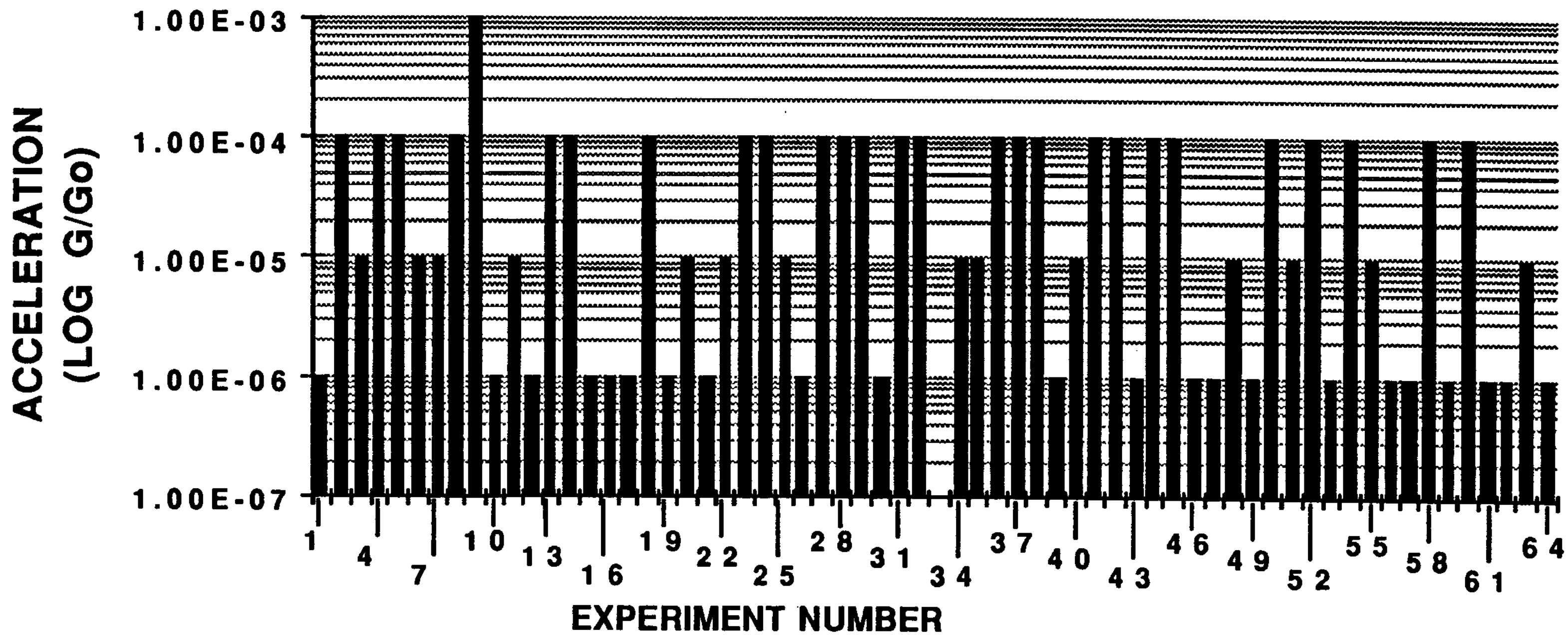
ORIGINAL PAGE IS OF POOR QUALITY

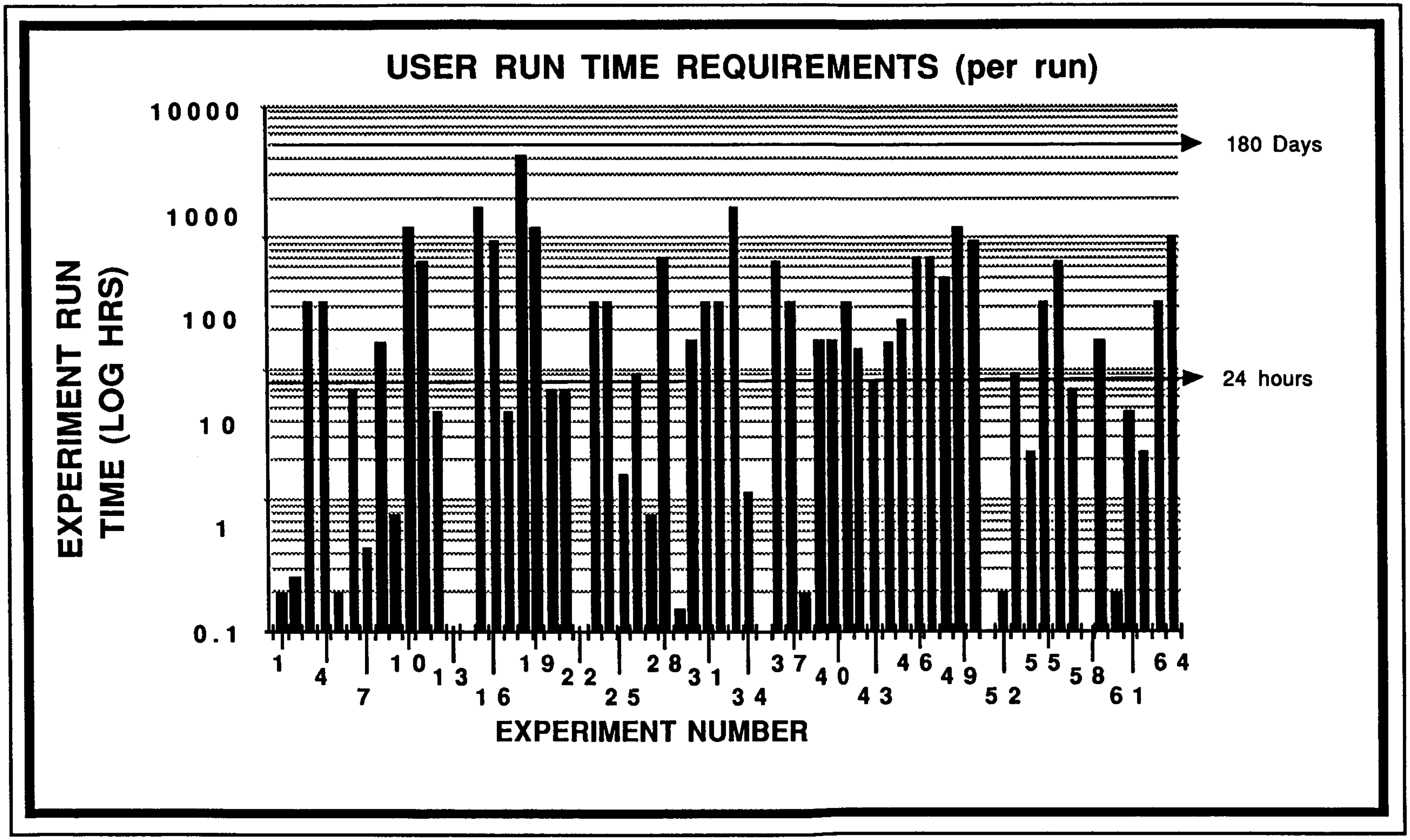
ORIGINAL PAGE IS OF POOR QUALITY


USER PEAK POWER REQUIREMENTS
PEAK POWER (LOG KILOWATTS)
10.00
1.00
0.10
0.01
7 KILOWATT
1 KILOWATT
1
4
7
10
13
16
19
22
25
28
31
34
37
40
43
46
49
52
55
58
61
64
EXPERIMENT NUMBER

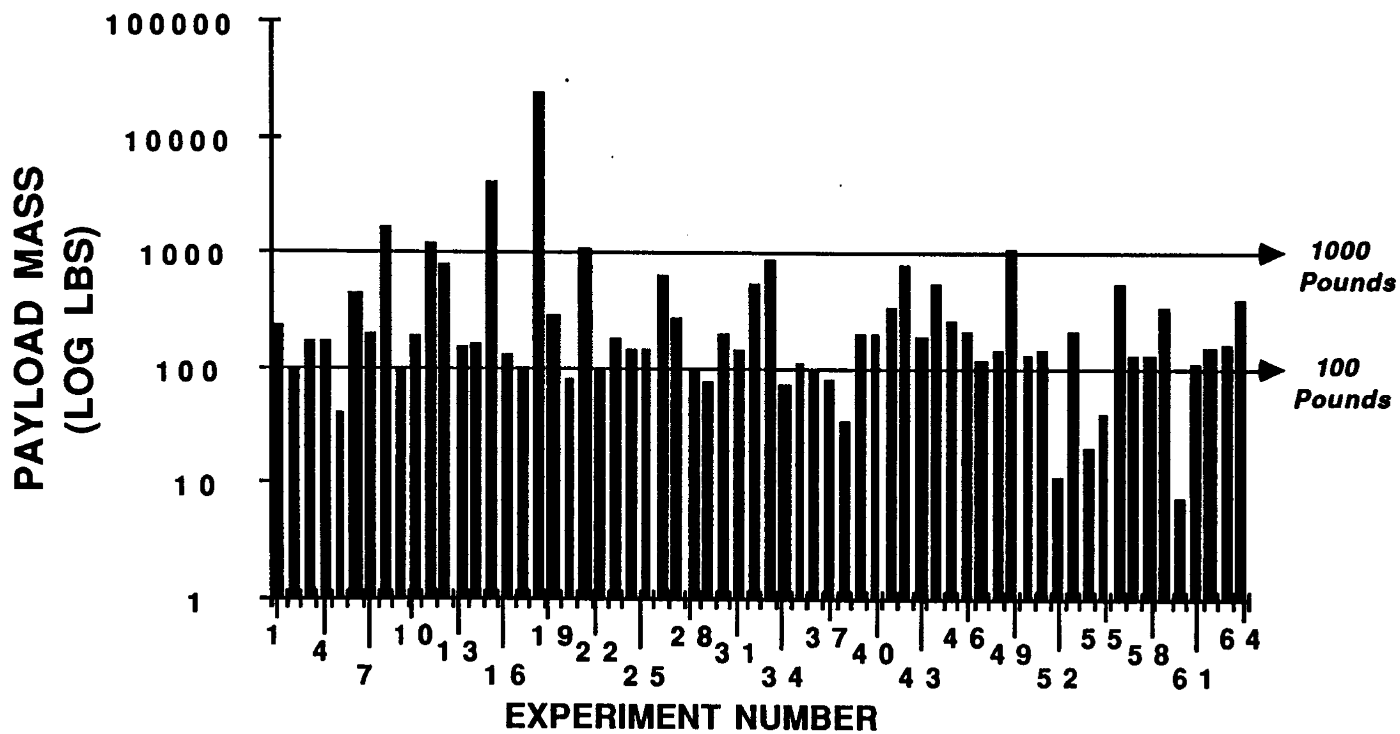

USER AVERAGE POWER REQUIRMENTS
AVERAGE POWER
(LOG KILOWATTS)
10.00
1.00
0.10
0.01
6 KILOWATT
1 KILOWATT
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64
EXPERIMENT NUMBER

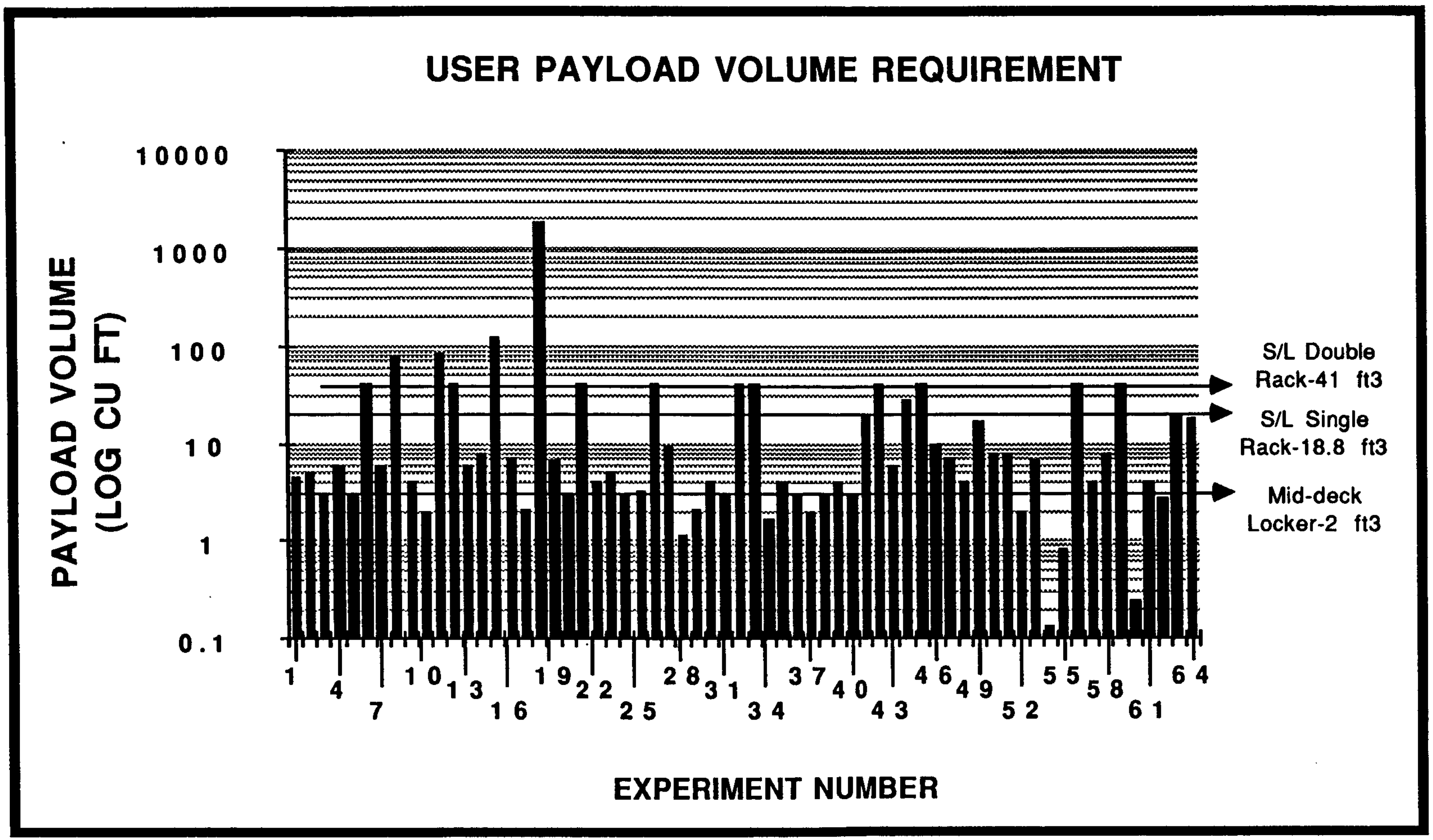
USER ACCELERATION REQUIREMENTS



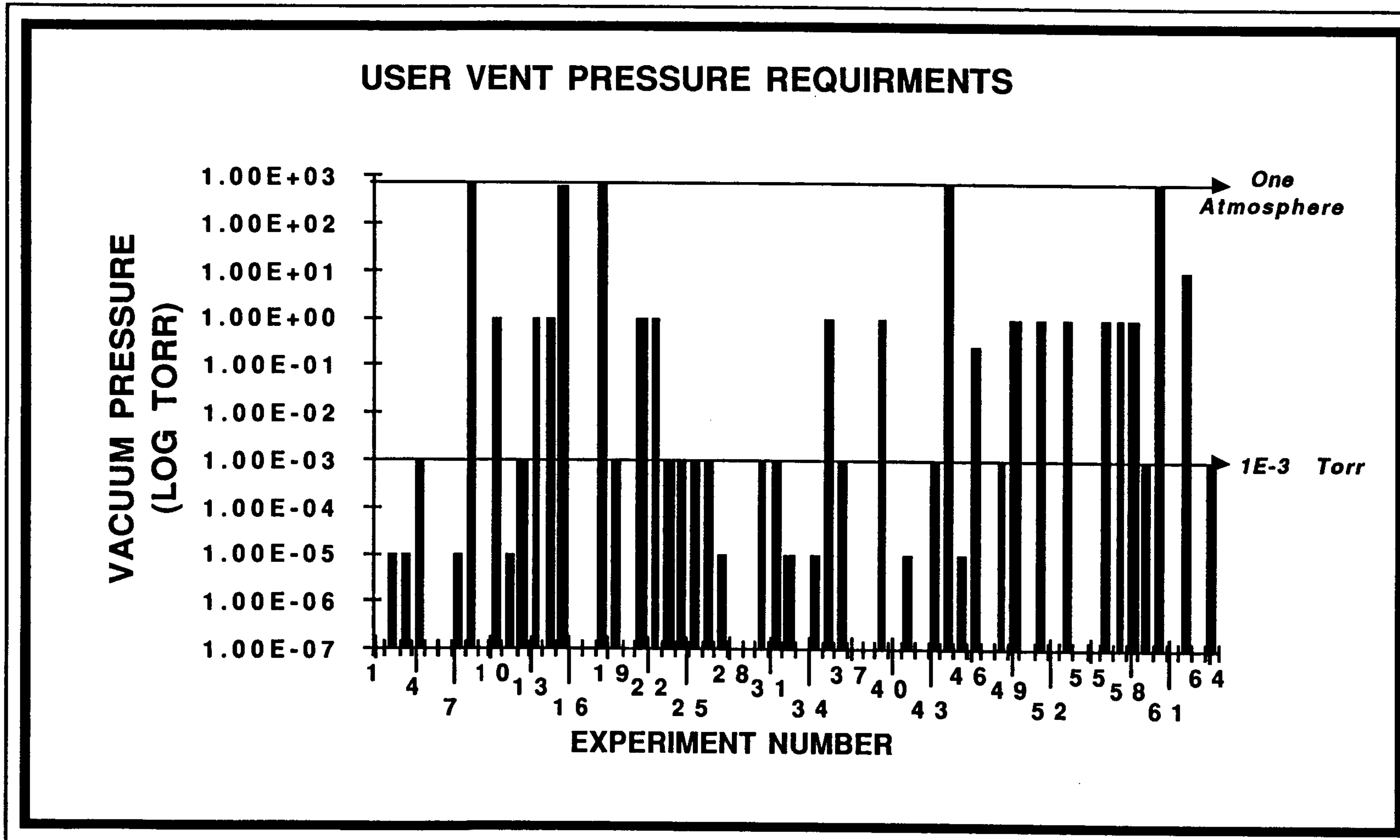

USER RUN TIME REQUIREMENTS (per run)
EXPERIMENT RUN TIME (LOG HRS)
10000
1000
100
10
1
0.1
180 Days
24 hours
1
4
7
10
13
16
19
22
25
28
31
34
37
40
43
46
49
52
55
58
61
64
EXPERIMENT NUMBER

USER PAYLOAD MASS REQUIREMENTS

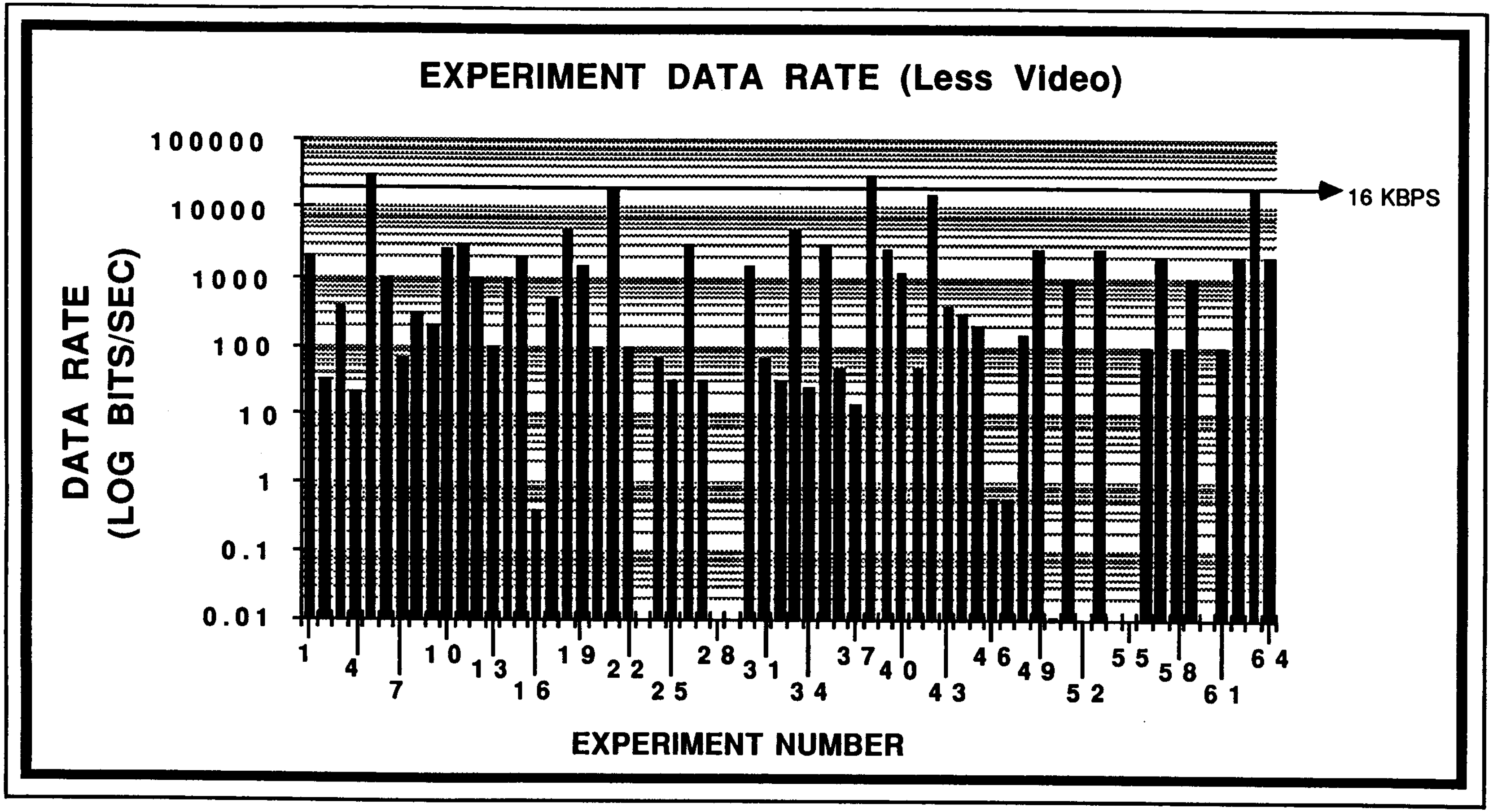


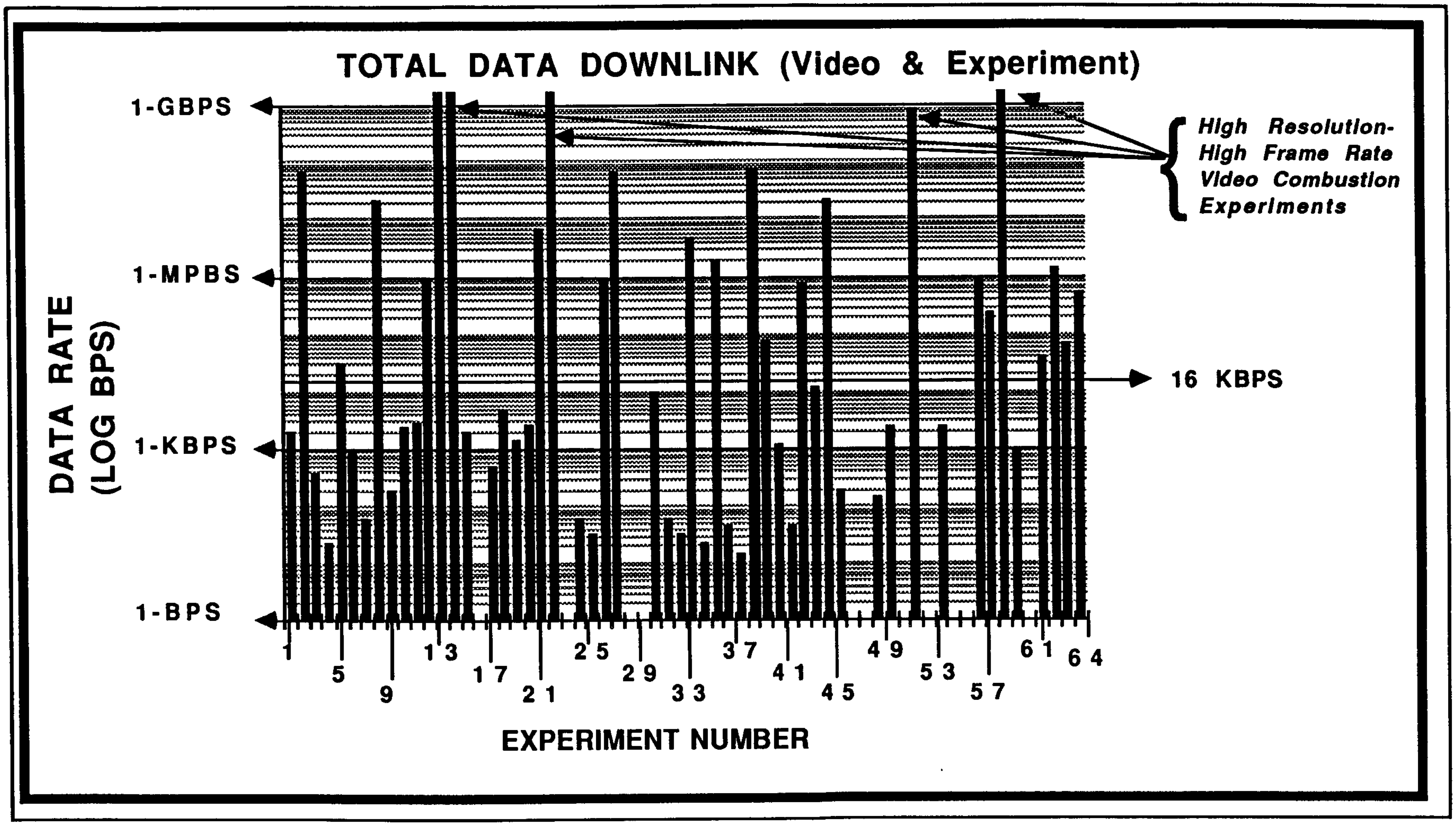


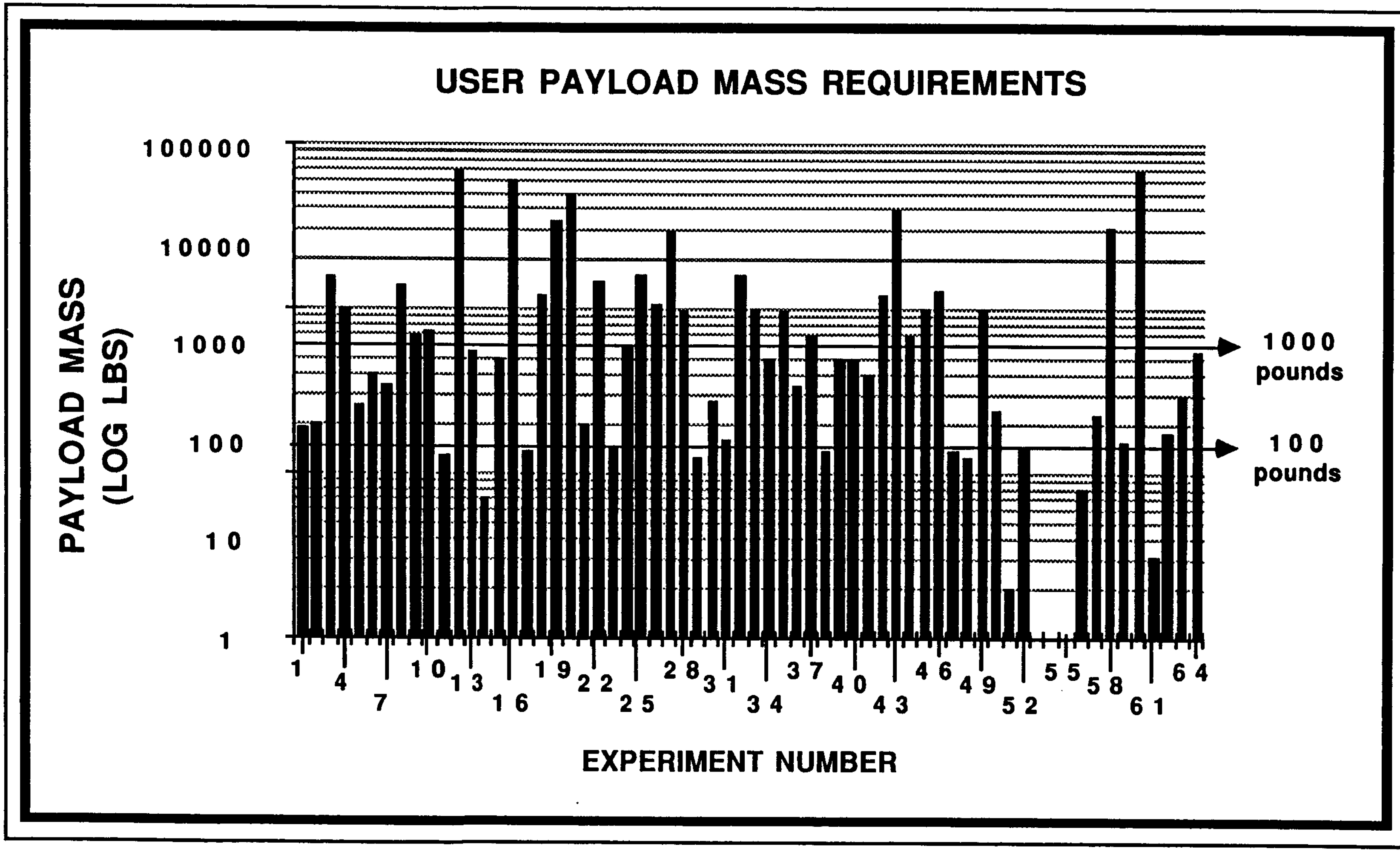
USER PAYLOAD VOLUME REQUIREMENT
PAYLOAD VOLUME
(LOG CU FT)
10000
1000
100
10
1
0.1
1
4
7
10
13
16
19
22
25
28
31
34
37
40
43
46
49
52
55
58
61
64
S/L Double Rack-41 ft3
S/L Single Rack-18.8 ft3
Mid-deck Locker-2 ft3
EXPERIMENT NUMBER

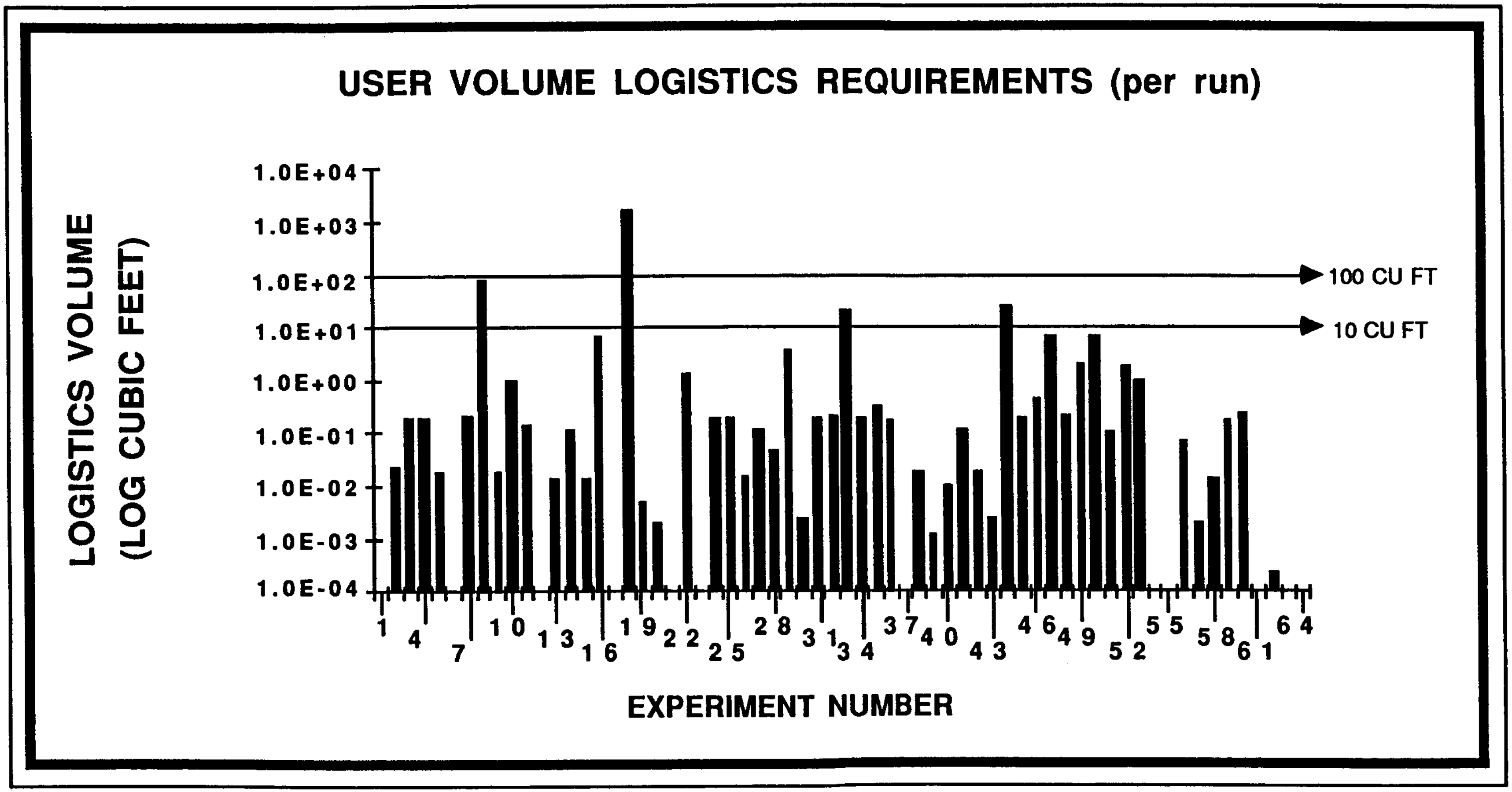


USER VENT PRESSURE REQUIRMENTS
VACUUM PRESSURE (LOG TORR)
1.00E+03
1.00E+02
1.00E+01
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
One Atmosphere
1E-3 Torr
1
4
7
10
13
16
19
22
25
28
31
34
37
40
43
46
49
52
55
58
61
64
EXPERIMENT NUMBER


EXPERIMENT DATA RATE (Less Video)
DATA RATE
(LOG BITS/SEC)
100000
10000
1000
100
10
1
0.1
0.01
16 KBPS
1
4
7
10
13
16
19
22
25
28
31
34
37
40
43
46
49
52
55
58
61
64
EXPERIMENT NUMBER


TOTAL DATA DOWNLINK (Video & Experiment)
DATA RATE (LOG BPS)
1-GBPS
1-MPBS
1-KBPS
1-BPS
High Resolution-High Frame Rate Video Combustion Experiments
16 KBPS
1
5
9
13
17
21
25
29
33
37
41
45
49
53
57
61
64
EXPERIMENT NUMBER


USER PAYLOAD MASS REQUIREMENTS
PAYLOAD MASS (LOG LBS)
100000
10000
1000
100
10
1
1000 pounds
100 pounds
1
4
7
10
13
16
19
22
25
28
31
34
37
40
43
46
49
52
55
58
61
64
EXPERIMENT NUMBER


USER VOLUME LOGISTICS REQUIREMENTS (per run)
LOGISTICS VOLUME
(LOG CUBIC FEET)
1.0E+04
1.0E+03
1.0E+02
1.0E+01
1.0E+00
1.0E-01
1.0E-02
1.0E-03
1.0E-04
100 CU FT
10 CU FT
1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49 52 55 58 61 64
EXPERIMENT NUMBER

REQUIREMENT SYNOPSIS SHEETS

Requirement Synopsis Sheets were developed for each of the 65 facilities in the RACO data base. These sheets were used to summarize user requirements for data, video, vacuum/vent, thermal/power, physical, crew, consumables, and microgravity level. The values for these requirements were taken from published documents or through contacts with the representative project managers and PIs. In cases where data were proprietary or otherwise unavailable, best estimates were developed on the basis of discussions with scientists conducting similar experimentation in ground-based labs.

The data requirements section focused on the downlink data required. Minimum experimental data were taken to be the minimum acceptable data link to permit process adjustments during and/or between runs. This level assumes on-board processing and data compression techniques. The video requirements were listed along with a percentage-to-ground requirement. This percentage was used to reduce the total video data rate to the rate desired for downlink. The video rate does not account for data compression techniques and/or other methods of lowering the data rate. Many facilities listed in the RACO data base do not require video downlink due to the use of film and on-board storage techniques in the hardware as currently configured. However, many PIs have expressed the desire to modify hardware for downlink of video on carrier missions of longer duration than the Shuttle's 7-day capability.

The vacuum requirements were given by the volume of gas to be vented (cubic feet at STP), longest time period allowable to achieve the venting, and the ultimate pressure required to conduct the experiment.

The thermal/power requirements consisted of the total peak power (both ac and dc) and total average power for each run. These power levels were taken from the power usage during previous missions for hardware that has flown, while worst-case power levels based on preliminary designs were determined for that hardware that has not flown. It should be noted that for hardware that has flown, power requirements are lower than the hardware's design capability. The run lengths included in this section were based on average run times per sample for similar ground-based experiments.

The physical requirements considered the payload's capability to be passed through a 52-in. hatch with corners rounded to a 12-in. radius. Comments concerning the payload's current configuration and necessary modifications for pressurized volume operation were included. Additionally, payload mass and volume were listed in pounds and cubic feet, respectively.

Each facility was analyzed to determine the minimum required crew and whether or not the hardware could be operated in a man-tended environment. If the facility could not be operated in the absence of crew, modifications such as addition of sample exchange mechanism, addition of programmable control, etc. were listed.

The consumables of each facility were listed by mass and volume for each material. All volumes for gases were at standard temperature and pressure. No volume nor mass for containers was included in the total.

The microgravity level was listed for each facility. This is the maximum steady-state g-level the process should encounter during operation.

EXPERIMENT NAME: Acoustic Containerless Exp

DATA:

Minimum Experimental Data (bits/sec): 2,000

Video Requirements

Resolution (lines): 525 X 525

Frame Rate (fps): 10

Percent to the ground: 0/Stored

VACUUM:

Standard Cubic Feet: 0

Longest Duration to Vent (hr): 0

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): 0.20

Average (kW): 0.16

Run Length (hr): 2

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

This facility is designed for an EAC.

Payload Mass (lb): 235

Payload Volume (cubic ft): 4.5

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 0

Volume (cubic ft): 0

MICROGRAVITY: 1E-6

EXPERIMENT NAME: Acoustic Levitator Furnace (ALF)

DATA:

Minimum Experimental Data (bits/sec): 32

Video Requirements

Resolution (lines): 240 X 520

Frame Rate (fps): 30

Percent to the ground: 90%

VACUUM:

Standard Cubic Feet: 1.305

Longest Duration to Vent (hr): 4.1

Vent Pressure (torr): 1E-5

THERMAL POWER:

Peak (kW): 1.54

Average (kW): 0.7

Run Length (hr): 2.62

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Designed to occupy a portion of a Spacelab single rack.

Payload Mass (lb): 100.31

Payload Volume (cubic ft): 5.023

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Add sample changeout mechanism. Add additional process gas capacity.

CONSUMABLES (give for each item):

Mass (lb): Sample: 0.016 lbm/run; Kryton Gas: 0.95 lb/run; Dry Air: 0.01

Volume (cubic ft): Sample: 0.00001/run; Kryton Gas: 0.022/run; Dry Air: 0.00066/run

MICROGRAVITY: 1E-4

EXPERIMENT NAME: AADSF

DATA:

Minimum Experimental Data (bits/sec): 400.00

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 1.55

Longest Duration to Vent (hr): 72

Vent Pressure (torr): 1E-5

THERMAL POWER:

Peak (kW): 1.0

Average (kW): 0.5

Run Length (hr): 336

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Must be reconfigured from EAC to fit in standard rack.

Payload Mass (lb): 16.5

Payload Volume (cubic ft): 3.1

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

Can add carousel for more runs, but furnace is fully automatic for 1 sample as is.

CONSUMABLES (give for each item):

Mass (lb): 12.0*

Volume (cubic ft): 0.21*

MICROGRAVITY: 1E-5

*Estimated

EXPERIMENT NAME: ADSF

DATA:

Minimum Experimental Data (bits/sec): 22.0

Video Requirements None

Resolution (lines): N/A X N/A

Frame Rate (fps): N/A

Percent to the ground: N/A

VACUUM:

Standard Cubic Feet: 5.25

Longest Duration to Vent (hr): 72

Vent Pressure (torr): 10-3

THERMAL POWER:

Peak (kW): 0.260

Average (kW): 0.150

Run Length (hr): 336

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Must be reconfigured from EAC to standard rack.

Payload Mass (lb): 170

Payload Volume (cubic ft): 6.04

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 12.0*

Volume (cubic ft): 0.2*

MICROGRAVITY: 4

*Estimated

EXPERIMENT NAME: Bubble Behavior Unit

DATA:

Minimum Experimental Data (bits/sec): 32

Video Requirements

Resolution (lines): 240 X 520

Frame Rate (fps): 30

Percent to the ground: 0/Stored

VACUUM:

Standard Cubic Feet: N/A

Longest Duration to Vent (hr): N/A

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): 0.4

Average (kW): 0.4

Run Length (hr): 2

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Fits in Spacelab.

Payload Mass (lb): 40

Payload Volume (cubic ft): 3.1

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Sample changeout handled by carousel and TV focusing.

CONSUMABLES (give for each item):

Mass (lb): 1

Volume (cubic ft): 0.2

MICROGRAVITY: 1E-4

EXPERIMENT NAME: Chemical Vapor Transport

DATA:

Minimum Experimental Data (bits/sec): 1,000*

Video Requirements

Resolution (lines): 1,025* X 1,025*

Frame Rate (fps): 10*

Percent to the ground: 0/Stored

VACUUM:

Standard Cubic Feet: 0

Longest Duration to Vent (hr): 0

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): 0.350

Average (kW): 0.300

Run Length (hr): 72

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 440

Payload Volume (cubic ft): 41

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Needs sample translator adjustor mechanism.

CONSUMABLES (give for each item):

Mass (lb): 0

Volume (cubic ft): 0

MICROGRAVITY: 1E-5

*Estimated

EXPERIMENT NAME: Continuous Heating Furnace (CHF)

DATA:

Minimum Experimental Data (bits/sec): 64

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 5.88

Longest Duration to Vent (hr): 72

Vent Pressure (torr): 1E-5

THERMAL POWER:

Peak (kW): 1.4

Average (kW): 0.370

Run Length (hr): 4.28

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

None

Payload Mass (lb): 198.42

Payload Volume (cubic ft): 5.877

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 19.56*

Volume (cubic ft): 0.23*

MICROGRAVITY: 5

*Estimated

EXPERIMENT NAME: Continuous Flow Electrophoresis System

DATA:

Minimum Experimental Data (bits/sec): 300

Video Requirements

Resolution (lines): 190 X 190

Frame Rate (fps): 30

Percent to the ground: 100% (0.5 hr/day)

VACUUM:

Standard Cubic Feet: 0.0036/sec (0.002 lb/sec)

Longest Duration to Vent (hr): Continuous

Vent Pressure (torr): 620

THERMAL POWER:

Peak (kW): 0.68

Average (kW): 0.55

Run Length (hr): 160

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Requires one SS double and one single rack.

Payload Mass (lb): 1,638

Payload Volume (cubic ft): 81

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Replace manual valves and switches with automatic systems.

CONSUMABLES (give for each item):

Mass (lb): 1,000

Volume (cubic ft): 60

MICROGRAVITY: 1E-4

EXPERIMENT NAME: Critical Fluid Scattering Exp

DATA:

Minimum Experimental Data (bits/sec): 200*

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: None

Longest Duration to Vent (hr): None

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): 0.750*

Average (kW): 0.750*

Run Length (hr): 8

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 100

Payload Volume (cubic ft): 4.0

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 1*

Volume (cubic ft): 0.02*

MICROGRAVITY: 1E-3

*Estimated

EXPERIMENT NAME: Diffusive Mixing or Organic Solutions (DMOS)

DATA:

Minimum Experimental Data (bits/sec): 2,500

Video Requirements

Resolution (lines): N/A X N/A

Frame Rate (fps): N/A

Percent to the ground: 80%

VACUUM:

Standard Cubic Feet: 0.5295

Longest Duration to Vent (hr): 1.0

Vent Pressure (torr): 1

THERMAL POWER:

Peak (kW): 0.130

Average (kW): 0.100

Run Length (hr): 168-1200

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

The diffusive mixing of organic solution is operated in an experiment apparatus container (EAC). The experiment can be configured with one EAC or multiple EACs, based on the space available in a middeck locker.

Payload Mass (lb): 188 (2 modules, 376)

Payload Volume (cubic ft): 2.01 (2 modules, 4.02)

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 0.16402

Volume (cubic ft): 1.06

MICROGRAVITY: 1E-6

EXPERIMENT NAME: Directional Solidification Furnace

DATA:

Minimum Experimental Data (bits/sec):

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet:

Longest Duration to Vent (hr):

Vent Pressure (torr):

THERMAL POWER:

Peak (kW): 7.0

Average (kW): 1.4

Run Length (hr): 672*

Physical:

Can the facility pass through the Space Station hatch? (Y/N): N

Comment:

Furnace will not fit through hatch.

Payload Mass (lb): 1,200*

Payload Volume (cubic ft): 82*

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb):

Volume (cubic ft):

MICROGRAVITY:

*Estimated

EXPERIMENT NAME: Drop Dynamics Module

DATA:

Minimum Experimental Data (bits/sec): 1,000*

Video Requirements

Resolution (lines): Standard X Shuttle Capability

Frame Rate (fps):

Percent to the ground: 0/Stored

VACUUM:

Standard Cubic Feet:

Longest Duration to Vent (hr):

Vent Pressure (torr): 1E-3

THERMAL POWER:

Peak (kW): 0.550

Average (kW): 0.500

Run Length (hr): 48

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 792

Payload Volume (cubic ft): 41.5

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Build in video.

CONSUMABLES (give for each item):

Mass (lb):

Volume (cubic ft):

MICROGRAVITY: 1E-6

EXPERIMENT NAME: Droplet Combustion Experiment (DCE)

DATA:

Minimum Experimental Data (bits/sec): 100

Video Requirements

Resolution (lines): 1,000 X 1,000

Frame Rate (fps): 400

Percent to the ground: 20

VACUUM:

Standard Cubic Feet: 2

Longest Duration to Vent (hr): 24

Vent Pressure (torr): 1

THERMAL POWER:

Peak (kW): 72

Average (kW): 72

Run Length (hr): 1

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 151.8

Payload Volume (cubic ft): 6

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

The current DCE does not have sample changeout capabilities. Currently exps are run by crew injecting fuel runs last only 10 to 15 sec and only 10 run available cleaning.

CONSUMABLES (give for each item):

Mass (lb): Fuel: 0.13; O2: 0.033; N2: 0.115

Volume (cubic ft): Fuel: 0.0028; O2: 0.002; N2: 0.009

MICROGRAVITY: 1E-4

EXPERIMENT NAME: Droplet Technology Demonstration (DTD)

DATA:

Minimum Experimental Data (bits/sec): 1,000

Video Requirements

Resolution (lines): 1,000 X 1,000

Frame Rate (fps): 400

Percent to the ground: 20

VACUUM:

Standard Cubic Feet: 20

Longest Duration to Vent (hr): 24

Vent Pressure (torr): 1

THERMAL POWER:

Peak (kW): 500

Average (kW): 250

Run Length (hr): 1

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 161.04

Payload Volume (cubic ft): 8

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Requires intensive crew interaction for cleanup between runs - one run lasts less than 1 min.

CONSUMABLES (give for each item):

Mass (lb): Fuel: 0.825; O2: 1.33; N2: 2.15

Volume (cubic ft): Fuel: 0.014; O2: 0.02; N2: 0.09

MICROGRAVITY: 1E-4

EXPERIMENT NAME: Electroepitaxial Crystal Growth

DATA:

Minimum Experimental Data (bits/sec): 2,000

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 3

Longest Duration to Vent (hr): 1,152

Vent Pressure (torr): 600*

THERMAL POWER:

Peak (kW): 6

Average (kW): 6

Run Length (hr): 1,680

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 4,103

Payload Volume (cubic ft): 124.6

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): GH2

Volume (cubic ft): 3

MICROGRAVITY: 1E-6

*Estimated

EXPERIMENT NAME: Electrodeposition (EDEP)

DATA:

Minimum Experimental Data (bits/sec): 0.38

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: N/A

Longest Duration to Vent (hr): N/A

Vent Pressure (torr): N/A

THERMAL POWER:

Peak (kW): 0.14

Average (kW): 0.02

Run Length (hr): 960

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 132.28

Payload Volume (cubic ft): 7.063

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 6.6

Volume (cubic ft): 7.1

MICROGRAVITY: 1E-6

EXPERIMENT NAME: Electromagnetic Levitator

DATA:

Minimum Experimental Data (bits/sec): Stored on orbit

Video Requirements Film Camera

Resolution (lines): X

Frame Rate (fps):

Percent to the ground: 0/stored

VACUUM:

Standard Cubic Feet: <1

Longest Duration to Vent (hr): 720

Vent Pressure (torr): 1E-7

THERMAL POWER:

Peak (kW): 1.204

Average (kW): 0.5

Run Length (hr): 48

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Designed for EAC on MSL and is not qualified for manned environment.

Payload Mass (lb): 92.4

Payload Volume (cubic ft): 2.1

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 0

Volume (cubic ft): 0

MICROGRAVITY: 1E-6

EXPERIMENT NAME: Electrophoresis Operating System

DATA:

Minimum Experimental Data (bits/sec): 5,000

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 0.054/sec (0.0027 lb/sec)

Longest Duration to Vent (hr): Continuous

Vent Pressure (torr): 620

THERMAL POWER:

Peak (kW): 3.5 min; 5.6 desired

Average (kW): 3.5 min; 5.6 desired

Run Length (hr): 4,320 (180 days)

Physical:

Can the facility pass through the Space Station hatch? (Y/N): N

Comment:

EOS is a self-contained module that needs to be docked to CDSF. Alternative would be to assemble EOS hardware in CDSF on the ground as fixed part of module. Sterilization and resupply module would need to be docked to CDSF in this configuration.

Payload Mass (lb): 24,600

Payload Volume (cubic ft): 1,767

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 24,600

Volume (cubic ft): 1,767

MICROGRAVITY: 1E-4

EXPERIMENT NAME: Float Zone Crystal Growth Facility

DATA:

Minimum Experimental Data (bits/sec): 1,500

Video Requirements

Resolution (lines): N/A X N/A

Frame Rate (fps):

Percent to the ground: 60%

VACUUM:

Standard Cubic Feet: 1.059*

Longest Duration to Vent (hr): 24.0*

Vent Pressure (torr): 1E-3

THERMAL POWER:

Peak (kW): 5

Average (kW): 2.5

Run Length (hr): 48-1200

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

In the proof of concept mode this experiment can be mounted in a middeck locker. It is housed in an EAC.

Payload Mass (lb): 295

Payload Volume (cubic ft): 6.53

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

In the proof of concept phase sample(s) diameter and length will not experience extensive necking and breakage.

CONSUMABLES (give for each item):

Mass (lb): 0.095; Argon 0.055; Air 0.04

Volume (cubic ft): 28/28.32/200 = 0.00494; Argon 396.48

MICROGRAVITY: 1E-6

EXPERIMENT NAME: Fluids Experiment Apparatus (FEA)

DATA:

Minimum Experimental Data (bits/sec): 100

Video Requirements

Resolution (lines): 250 X 250

Frame Rate (fps): 0.02

Percent to the ground: 10

VACUUM:

Standard Cubic Feet: None

Longest Duration to Vent (hr): None

Vent Pressure (torr): 0

THERMAL POWER:

Peak (kW): 200

Average (kW): 50

Run Length (hr): 72

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 79.2

Payload Volume (cubic ft): 3

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Crew required for sample changeout. More expensive to mod for auto change than facility cost to build.

CONSUMABLES (give for each item):

Mass (lb): Sample: 0.125

Volume (cubic ft): Sample: 0.002

MICROGRAVITY: 1E-5

EXPERIMENT NAME: Fluids Experiment System

DATA:

Minimum Experimental Data (bits/sec): 20,000

Video Requirements

Resolution (lines): 625 X 625

Frame Rate (fps): 30

Percent to the ground: 3%

VACUUM:

Standard Cubic Feet: 0.001

Longest Duration to Vent (hr): 1

Vent Pressure (torr): 1

THERMAL POWER:

Peak (kW): 1.484

Average (kW): 0.980

Run Length (hr): 72

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Designed for Spacelab double rack.

Payload Mass (lb): 1,084.6

Payload Volume (cubic ft): 41

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Robotics transfer of test cell from warm up to optical bench.

CONSUMABLES (give for each item):

Mass (lb): 0

Volume (cubic ft): 0

MICROGRAVITY: 1E-6

EXPERIMENT NAME: Gas-Jet Diffusion Flames Experiment (GDFE)

DATA:

Minimum Experimental Data (bits/sec): 100

Video Requirements

Resolution (lines): 1,000 X 1,000

Frame Rate (fps): 400

Percent to the ground: 20

VACUUM:

Standard Cubic Feet: 5

Longest Duration to Vent (hr): 1/60 (Note: This is a flowing exp. Therefore, min = mout.)

Vent Pressure (torr): 1

THERMAL POWER:

Peak (kW): 150

Average (kW): 150

Run Length (hr): 1

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 100

Payload Volume (cubic ft): 4

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Facility requires crew to clean between runs. This is laborious and runs only last a few hours at the most.

CONSUMABLES (give for each item):

Mass (lb): Fuel (GH2): 1.1; G0: 4.5; GN2: 0.44

Volume (cubic ft): Fuel (GH2): 1.1, G0: 0.271; GN2: 0.031

MICROGRAVITY: 1E-5

EXPERIMENT NAME: GFGAS

DATA:

Minimum Experimental Data (bits/sec): 0

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 5.2*

Longest Duration to Vent (hr): 72

Vent Pressure (torr): 1E-3

THERMAL POWER:

Peak (kW): 0.600*

Average (kW): 0.200*

Run Length (hr): 336

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Must be reconfigured from EAC to standard rack.

Payload Mass (lb): 180

Payload Volume (cubic ft): 5

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 0

Volume (cubic ft): 0

MICROGRAVITY: 4

*Estimated

EXPERIMENT NAME: Gradient-General Purpose Rocket Furnace (G-GPRF)

DATA:

Minimum Experimental Data (bits/sec): 64*

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 5.3

Longest Duration to Vent (hr): 72

Vent Pressure (torr): 10-3

THERMAL POWER:

Peak (kW): 1.600

Average (kW): 1.000

Run Length (hr): 336

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Was designed for MSL, may need to be repackaged.

Payload Mass (lb): 145

Payload Volume (cubic ft): 3

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 13.5

Volume (cubic ft): 0.2

MICROGRAVITY: 4

*Estimated

EXPERIMENT NAME: Gradient Heating Furnace (GHF)

DATA:

Minimum Experimental Data (bits/sec): 32*

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 5.1

Longest Duration to Vent (hr): 72

Vent Pressure (torr): 10-3

THERMAL POWER:

Peak (kW): 1.080

Average (kW): 0.450

Run Length (hr): 15.43

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

None

Payload Mass (lb): 144.4

Payload Volume (cubic ft): 3.524

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 12.0*

Volume (cubic ft): 0.21*

MICROGRAVITY: 5

*Estimated

EXPERIMENT NAME: High Temp Acoustic Lev

DATA:

Minimum Experimental Data (bits/sec):	3,000	
Video Requirements	Desired for advanced hardware	
Resolution (lines):	TBD	X TBD
Frame Rate (fps):	TB D	
Percent to the ground:	TB D	

VACUUM:

Standard Cubic Feet: 3.2

Longest Duration to Vent (hr): 48

Vent Pressure (torr): 1E-3

THERMAL POWER:

Peak (kW): 2.88

Average (kW): 1

Run Length (hr): 1 per sample max; 96 automated

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 649

Payload Volume (cubic ft): 41

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): GN2

Volume (cubic ft): 3.2

MICROGRAVITY: 1E-6

EXPERIMENT NAME: Image Furnace (IMF)

DATA:

Minimum Experimental Data (bits/sec): 32

Video Requirements

Resolution (lines): 240 X 520

Frame Rate (fps): 30

Percent to the ground: 90%

VACUUM:

Standard Cubic Feet: 21.93

Longest Duration to Vent (hr): 6.9

Vent Pressure (torr): 1E-5

THERMAL POWER:

Peak (kW): 0.97

Average (kW): 0.70

Run Length (hr): 7.67

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Designed to occupy a portion of a Spacelab single rack.

Payload Mass (lb): 271.17

Payload Volume (cubic ft): 9.547

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Add automated sample changeout mechanism. Add additional process gas capacity.

CONSUMABLES (give for each item):

Mass (lb): Sample: 0.9/run; Argon Gas: 2.443/run; Dry Air: 0.05/run

Volume (cubic ft): Sample: 0.00166/run; Argon Gas: 0.12/run; Dry Air: 0.0033/run

MICROGRAVITY: 1E-4

EXPERIMENT NAME: Initial Blood Storage Experiment

DATA:

Minimum Experimental Data (bits/sec): None

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: None

Longest Duration to Vent (hr):

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): 0.125

Average (kW): 0.125

Run Length (hr): 720 (refrigerated blood deteriorates rapidly after 30 days)

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Fits in an STS middeck locker.

Payload Mass (lb): 103

Payload Volume (cubic ft): 1.14

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 3.25

Volume (cubic ft): 0.05

MICROGRAVITY: 1E-4

EXPERIMENT NAME: Isoelectric Focusing Facility

DATA:

Minimum Experimental Data (bits/sec): None

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: None

Longest Duration to Vent (hr):

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): 0.28

Average (kW): 0.20

Run Length (hr): 1.5

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Fits in an STS middeck EAC.

Payload Mass (lb): 76.5

Payload Volume (cubic ft): 2.08

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Automate cooling system; automate on-off switches, control.

CONSUMABLES (give for each item):

Mass (lb): 100

Volume (cubic ft): 4.02

MICROGRAVITY: 1E-4

EXPERIMENT NAME: Isothermal Dendritic Growth Experiment

DATA:

Minimum Experimental Data (bits/sec): 1,500

Video Requirements

Resolution (lines): 525 X 525

Frame Rate (fps): 60

Percent to the ground: 80%

VACUUM:

Standard Cubic Feet:

Longest Duration to Vent (hr): 18.0

Vent Pressure (torr): 1E-3*

THERMAL POWER:

Peak (kW): 0.160*

Average (kW): 0.100*

Run Length (hr): 24-168*

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Experiment will require three middeck lockers or equivalent volume.

Payload Mass (lb): 200*

Payload Volume (cubic ft): 4.02*

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 0.04*

Volume (cubic ft): 396.48*; 14/28.32/200*; 0.004*

MICROGRAVITY: 1E-6

*Estimated

EXPERIMENT NAME: Isothermal-General Purpose Rocket Furnace

DATA:

Minimum Experimental Data (bits/sec): 64*

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 5.3

Longest Duration to Vent (hr): 72

Vent Pressure (torr): 10-3

THERMAL POWER:

Peak (kW): 1.600

Average (kW): 1.000

Run Length (hr): 336

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Must be reconfigured from EAC to standard rack.

Payload Mass (lb): 1,451

Payload Volume (cubic ft): 3

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 13.5*

Volume (cubic ft): 0.20*

MICROGRAVITY: 4

*Estimated

EXPERIMENT NAME: Isothermal Heating Furnace

DATA:

Minimum Experimental Data (bits/sec): 32

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 6.2

Longest Duration to Vent (hr): 72

Vent Pressure (torr): 10-5

THERMAL POWER:

Peak (kW): 1.000

Average (kW): 0.500

Run Length (hr): 336

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

None

Payload Mass (lb): 550*

Payload Volume (cubic ft): 41*

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 14.0*

Volume (cubic ft): 0.22*

MICROGRAVITY: 4

*Estimated

EXPERIMENT NAME: Lambdu Point

DATA:

Minimum Experimental Data (bits/sec): 5,000

Video Requirements Desired for advanced hardware

Resolution (lines): TBD X TBD

Frame Rate (fps): TBD

Percent to the ground: TBD

VACUUM:

Standard Cubic Feet: 12,345.0*

Longest Duration to Vent (hr): 2,160

Vent Pressure (torr): 1E-7

THERMAL POWER:

Peak (kW): 0.5

Average (kW): 0.45

Run Length (hr): 1,680

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Cryogenic dewars are not safety qualified.

Payload Mass (lb): 880

Payload Volume (cubic ft): 41

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 28* LN2; 140* LHe

Volume (cubic ft): 3.53* LN2, 17.65* LHe

MICROGRAVITY: 1E-6 or better

*Estimated

EXPERIMENT NAME: Large Isothermal Furnace (LIF)

DATA:

Minimum Experimental Data (bits/sec): 24*

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 8.3

Longest Duration to Vent (hr): 72

Vent Pressure (torr): 10-5

THERMAL POWER:

Peak (kW): 0.975

Average (kW): 0.360

Run Length (hr): 11.93

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

None

Payload Mass (lb): 72.75

Payload Volume (cubic ft): 1.678

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 12.0*

Volume (cubic ft): 0.21*

MICROGRAVITY: 5

*Estimated

EXPERIMENT NAME: Liquid Drop Experiment Facility (LDF)

DATA:

Minimum Experimental Data (bits/sec): 3,000

Video Requirements

Resolution (lines): 1,000 X 1,000

Frame Rate (fps): 1

Percent to the ground: 10

VACUUM:

Standard Cubic Feet: 0.039

Longest Duration to Vent (hr): 24

Vent Pressure (torr): 1

THERMAL POWER:

Peak (kW): 0.338

Average (kW): 0.312

Run Length (hr): 1

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 132

Payload Volume (cubic ft): 4

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Sample is manually injected. Could be modified.

CONSUMABLES (give for each item):

Mass (lb): Oil 0.243; GN2 0.0012

Volume (cubic ft): Oil 0.3115; GN2 0.0167

MICROGRAVITY: 1E-5

EXPERIMENT NAME: Low Temp Gradient Heating Furnace

DATA:

Minimum Experimental Data (bits/sec): 48

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 4.2

Longest Duration to Vent (hr): 72

Vent Pressure (torr): 10-3

THERMAL POWER:

Peak (kW): 0.700

Average (kW): 0.360

Run Length (hr): 672*

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

None

Payload Mass (lb): 100

Payload Volume (cubic ft): 3.1

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 8.0*

Volume (cubic ft): 0.19*

MICROGRAVITY: 4

*Estimated

EXPERIMENT NAME: Magnetic Isolation System

DATA:

Minimum Experimental Data (bits/sec): 15*

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: None

Longest Duration to Vent (hr): None

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): 0.140

Average (kW): 0.140

Run Length (hr): 336

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Fits in middeck locker.

Payload Mass (lb): 80

Payload Volume (cubic ft): 2.01

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb):

Volume (cubic ft):

MICROGRAVITY: N/A

EXPERIMENT NAME: Margoni Convection

DATA:

Minimum Experimental Data (bits/sec): 32

Video Requirements

Resolution (lines): 240 X 520

Frame Rate (fps): 30

Percent to the ground: 100% video

VACUUM:

Standard Cubic Feet: None

Longest Duration to Vent (hr): None

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): 0.5

Average (kW): 0.42

Run Length (hr):

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Fits in Spacelab

Payload Mass (lb): 35

Payload Volume (cubic ft): 3.1

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Sample changeout on carousel.

CONSUMABLES (give for each item):

Mass (lb): 1

Volume (cubic ft): 0.2

MICROGRAVITY: 1E-4

EXPERIMENT NAME: Mechanics of Granular Materials (MGM)

DATA:

Minimum Experimental Data (bits/sec): 2,500

Video Requirements

Resolution (lines): 525 X 525

Frame Rate (fps): 1/60

Percent to the ground: 80%

VACUUM:

Standard Cubic Feet:

Longest Duration to Vent (hr):

Vent Pressure (torr): 1*

THERMAL POWER:

Peak (kW): 0.500*

Average (kW): 0.300*

Run Length (hr): 24-168*

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 200*

Payload Volume (cubic ft): 4.02*

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 0.02*

Volume (cubic ft): 0.00123*

MICROGRAVITY: 1E-6

*Estimated

EXPERIMENT NAME: Mephisto

DATA:

Minimum Experimental Data (bits/sec): 1,200

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: None

Longest Duration to Vent (hr): 24

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): 0.400

Average (kW): 0.25

Run Length (hr): 165

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Designed for an EAC.

Payload Mass (lb): 200

Payload Volume (cubic ft): 3.1

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

Crew required for sample changeout.

CONSUMABLES (give for each item):

Mass (lb): 0.01

Volume (cubic ft): 0.01

MICROGRAVITY: 1E-5

EXPERIMENT NAME: Mirror Furnace (MHF)

DATA:

Minimum Experimental Data (bits/sec): 48*

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 7.4

Longest Duration to Vent (hr): 72

Vent Pressure (torr): 10-5

THERMAL POWER:

Peak (kW): 1.200

Average (kW): 0.400

Run Length (hr): 336

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

None

Payload Mass (lb): 330*

Payload Volume (cubic ft): 18.8*

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 9.0*

Volume (cubic ft): 0.12*

MICROGRAVITY: 4

*Estimated

EXPERIMENT NAME: MEL

DATA:

Minimum Experimental Data (bits/sec): 16,000

Video Requirements

- **Resolution (lines):** 280 X 520
- **Frame Rate (fps):** 5
- **Percent to the ground:** 5

VACUUM:

Standard Cubic Feet: 4

Longest Duration to Vent (hr): 24

Vent Pressure (torr): 1E-7

THERMAL POWER:

Peak (kW): 3.970

Average (kW): 1.525

Run Length (hr): 144

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 770

Payload Volume (cubic ft): 41

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 0.32

Volume (cubic ft): 0.002

MICROGRAVITY: 1E-4

EXPERIMENT NAME: Monodisperse Latex Reactor System

DATA:

Minimum Experimental Data (bits/sec): 400

Video Requirements

Resolution (lines): 240 X 240

Frame Rate (fps):

Percent to the ground: 60%

VACUUM:

Standard Cubic Feet: 0.1765*

Longest Duration to Vent (hr): 4*

Vent Pressure (torr): 1E-3

THERMAL POWER:

Peak (kW): 0.7

Average (kW): 0.35

Run Length (hr): 20-80

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Configuration for this experiment can range from a single rack to three middeck lockers or the equivalent side by side with support electronics, the reactors are contained in an EAC.

Payload Mass (lb): 198.4

Payload Volume (cubic ft): 6.03

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

Some automated method must be implemented that would allow for a sample of the material to be taken and viewed under magnification and transmitted to the ground to determine if the run is successful.

CONSUMABLES (give for each item):

Mass (lb): 0.04

Volume (cubic ft): 396.48

MICROGRAVITY: 1E-6

*Estimated

EXPERIMENT NAME: Moving Wall Electrophoresis Unit

DATA:

Minimum Experimental Data (bits/sec): 300

Video Requirements

Resolution (lines): 190 X 190

Frame Rate (fps): 30

Percent to the ground: 100% (0.5 hr/day)

VACUUM:

Standard Cubic Feet: 0.0036/sec (0.0002 lb/sec)

Longest Duration to Vent (hr): Continuous

Vent Pressure (torr): 620

THERMAL POWER:

Peak (kW): 1.0

Average (kW): 0.88

Run Length (hr): 160

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Hardware is in concept phase and could be configured to fit in a standard SS rack.

Payload Mass (lb): 556

Payload Volume (cubic ft): 27

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

Initially conceived for Spacelab but pumps and valves could be automated.

CONSUMABLES (give for each item):

Mass (lb): 556

Volume (cubic ft): 27

MICROGRAVITY: 1E-4

EXPERIMENT NAME: MEPF

DATA:

Minimum Experimental Data (bits/sec): 48-200*

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet:

Longest Duration to Vent (hr): 72

Vent Pressure (torr): 10-5

THERMAL POWER:

Peak (kW): 1.300

Average (kW): 1.000

Run Length (hr): 240

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Must be reconfigured from EAC to standard rack.

Payload Mass (lb): 250

Payload Volume (cubic ft): 41

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 12.0*

Volume (cubic ft): 0.2*

MICROGRAVITY: 4

*Estimated

EXPERIMENT NAME: Non-Linear Optical Monomers and Thin Films (NLOMTF)

DATA:

Minimum Experimental Data (bits/sec): 0.59

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 1.01

Longest Duration to Vent (hr): 5*

Vent Pressure (torr): 0.25

THERMAL POWER:

Peak (kW): 0.14

Average (kW): 0.14

Run Length (hr): 720

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 209.44

Payload Volume (cubic ft): 9.711

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 10.5

Volume (cubic ft): 0.48

MICROGRAVITY: 1E-6

*Estimated

EXPERIMENT NAME: Non-Linear Optical Organic Crystals (NLOOC)

DATA:

Minimum Experimental Data (bits/sec): 0.59

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: N/A

Longest Duration to Vent (hr): N/A

Vent Pressure (torr): N/A

THERMAL POWER:

Peak (kW): 0.128

Average (kW): 0.096

Run Length (hr): 720

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 119.05

Payload Volume (cubic ft): 7.063

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 6.6*

Volume (cubic ft): 7.1*

MICROGRAVITY: 1E-6

*Estimated

EXPERIMENT NAME: Normal Freezing Furnace

DATA:

Minimum Experimental Data (bits/sec): 144*

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet:

Longest Duration to Vent (hr): 72

Vent Pressure (torr): 10-3

THERMAL POWER:

Peak (kW): 1.000

Average (kW): 0.650

Run Length (hr): 504*

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

None

Payload Mass (lb): 150

Payload Volume (cubic ft): 4

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 13.39*

Volume (cubic ft): 0.22*

MICROGRAVITY: 5

*Estimated

EXPERIMENT NAME: Organic & Polymer Crystal Growth Experimentation (OPCGE)

DATA:

Minimum Experimental Data (bits/sec): 2,500

Video Requirements

Resolution (lines): N/A X N/A

Frame Rate (fps): N/A

Percent to the ground: 80%

VACUUM:

Standard Cubic Feet: 7.972*

Longest Duration to Vent (hr): 1.5*

Vent Pressure (torr): 1

THERMAL POWER:

Peak (kW): 0.250

Average (kW): 0.150

Run Length (hr): 168-1200

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

This experiment consists of three unique experiments, diffusive mixing, physical vapor, and a melt/growth (solidification) process. The DMOS and PVTOS experiments are housed in EACs that are rack mountable.

Payload Mass (lb): 1,089.00

Payload Volume (cubic ft): 17.08

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 0.328

Volume (cubic ft): 2.12

MICROGRAVITY: 1E-6

*Estimated

EXPERIMENT NAME: Organic Separations (ORSEP)

DATA:

Minimum Experimental Data (bits/sec): 0.011

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: N/A

Longest Duration to Vent (hr): N/A

Vent Pressure (torr): N/A

THERMAL POWER:

Peak (kW): 0.02

Average (kW): 0.02

Run Length (hr): 960

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 132.3

Payload Volume (cubic ft): 7.946

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 6.6*

Volume (cubic ft): 7.1*

MICROGRAVITY: 1E-4

*Estimated

EXPERIMENT NAME: Particle Cloud Combustion Exp. (PCCE)

DATA:

Minimum Experimental Data (bits/sec): 1,000

Video Requirements

Resolution (lines): 1,000 X 1,000

Frame Rate (fps): 400

Percent to the ground: 10

VACUUM:

Standard Cubic Feet: 0.2

Longest Duration to Vent (hr): 1/60

Vent Pressure (torr): 1

THERMAL POWER:

Peak (kW): 150

Average (kW): 75

Run Length (hr): 1

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 149.6

Payload Volume (cubic ft): 8

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

The current facility must be cleaned after ≈ 5 runs. Each run is ≈ 15 to 20 min in duration.

CONSUMABLES (give for each item):

Mass (lb): Fuel 0.17; O2 0.33; GN2 2015

Volume (cubic ft): Fuel 0.0028; O2 0.02, GN2 0.09

MICROGRAVITY: 1E-5

EXPERIMENT NAME: Phase Partitioning Experiment

DATA:

Minimum Experimental Data (bits/sec): None

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: None

Longest Duration to Vent (hr):

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): None (will require small amount of power if automated)

Average (kW):

Run Length (hr): 2

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Fits in an STS middeck locker.

Payload Mass (lb): 11.5 (includes still camera)

Payload Volume (cubic ft): 2.0 (volume accommodates camera)

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

Mount chambers in a vibration-generating device, use automatic camera system for photography.

CONSUMABLES (give for each item):

Mass (lb): 4.0

Volume (cubic ft): 2.00

MICROGRAVITY: 1E-4

EXPERIMENT NAME: Physical Vapor Transport of Organic Solutions (PVTOS)

DATA:

Minimum Experimental Data (bits/sec): 2500

Video Requirements

Resolution (lines): N/A X N/A

Frame Rate (fps): N/A

Percent to the ground: 80%

VACUUM:

Standard Cubic Feet: 0.5295*

Longest Duration to Vent (hr): 1.0*

Vent Pressure (torr): 1

THERMAL POWER:

Peak (kW): 0.190

Average (kW): 0.125

Run Length (hr): 16-96

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

PVTOS is accommodated by an experiment apparatus container (EAC). The experiment can exist in a configuration of one EAC or multiple EACs according to the space available. The EACs will fit in a middeck locker and the support equipment also.

Payload Mass (lb): 418.00

Payload Volume (cubic ft): 6.53

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 0.16402

Volume (cubic ft): 1.06

MICROGRAVITY: 1E-6

EXPERIMENT NAME: PCG I

DATA:

Minimum Experimental Data (bits/sec):	None		
Video Requirements	Nikkon Camera		
Resolution (lines):	TBD	X	TBD
Frame Rate (fps):	TBD		
Percent to the ground:	0/Stored		

VACUUM:

Standard Cubic Feet: None

Longest Duration to Vent (hr):

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): None

Average (kW):

Run Length (hr): 24

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 20

Payload Volume (cubic ft): 0.14

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): None

Volume (cubic ft):

MICROGRAVITY: 1E-4

EXPERIMENT NAME: PCG II & III

DATA:

Minimum Experimental Data (bits/sec): None

Video Requirements Nikkon Camera

Resolution (lines): TBD X TBD

Frame Rate (fps): TBD

Percent to the ground: 0/Stored

VACUUM:

Standard Cubic Feet: None

Longest Duration to Vent (hr):

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): None 0.80

Average (kW): 0.60

Run Length (hr): 336

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 40

Payload Volume (cubic ft): 0.84

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): None

Volume (cubic ft): None

MICROGRAVITY: 1E-5

EXPERIMENT NAME: PCG IV

DATA:

Minimum Experimental Data (bits/sec): 0

Video Requirements

Resolution (lines): 325 X 325

Frame Rate (fps): 5

Percent to the ground: 10%

VACUUM:

Standard Cubic Feet: 14.28

Longest Duration to Vent (hr): 48

Vent Pressure (torr): 1

THERMAL POWER:

Peak (kW): 0.230

Average (kW): 0.220

Run Length (hr): 672

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 550

Payload Volume (cubic ft): 41.3

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 1.1 GN2

Volume (cubic ft): 0.071

MICROGRAVITY: 1E-6

EXPERIMENT NAME: SAAL

DATA:

Minimum Experimental Data (bits/sec): 2,000

Video Requirements

Resolution (lines): 240 X 520

Frame Rate (fps): 1

Percent to the ground: 0/Stored

VACUUM:

Standard Cubic Feet: 0.042

Longest Duration to Vent (hr): 10

Vent Pressure (torr): 1

THERMAL POWER:

Peak (kW): 3.1

Average (kW): 2.6

Run Length (hr): 72

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Designed for EAC on MSL and is not flight qualified for manned environment.

Payload Mass (lb): 1,351

Payload Volume (cubic ft): 4

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 0.00016

Volume (cubic ft): 0.002

MICROGRAVITY: 1E-6

EXPERIMENT NAME: Solid Surface Combustion Exp (SSCE)

DATA:

Minimum Experimental Data (bits/sec): 100

Video Requirements

Resolution (lines): 1,000 X 1,000

Frame Rate (fps): 400

Percent to the ground: 10

VACUUM:

Standard Cubic Feet: 2

Longest Duration to Vent (hr): 24

Vent Pressure (torr): 1

THERMAL POWER:

Peak (kW): 156

Average (kW): 72

Run Length (hr): 1

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 129.8

Payload Volume (cubic ft): 8

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

The current PCCE does not have sample changeout capabilities. Currently exps are run by changing whole burn chambers out. One run lasts only 5 to 15 seconds. Only one run without cleaning.

CONSUMABLES (give for each item):

Mass (lb): Fuel 0.17; O2 1.033; N2 0.1150

Volume (cubic ft): Fuel 0.0028; O2 0.002; N2; 0.009

MICROGRAVITY: 1E-4

EXPERIMENT NAME: Space Ultra Vacuum Research Facility

DATA:

Minimum Experimental Data (bits/sec): 1,000

Video Requirements

Resolution (lines): N/A X N/A

Frame Rate (fps): N/A

Percent to the ground: 80%

VACUUM:

Standard Cubic Feet: 0.1766*

Longest Duration to Vent (hr): 1.5*

Vent Pressure (torr): 1E-3

THERMAL POWER:

Peak (kW): 7.0*

Average (kW): 3.5*

Run Length (hr): 24-168

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

The SUVRF will support a free flyer that can be retrieved and serviced and re-released.

Payload Mass (lb): 330.00

Payload Volume (cubic ft): 41.53

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 1.485*; Air 0.00256 kg /PR; GN2 0.6250 kg/R

Volume (cubic ft): 0.1766*; Air 2.0 L/PR; GN2 500 liters

MICROGRAVITY: 1E-6

*Estimated

EXPERIMENT NAME: Static Column Electrophoresis

DATA:

Minimum Experimental Data (bits/sec): None

Video Requirements None

Resolution (lines): X

Frame Rate (fps):

Percent to the ground:

VACUUM:

Standard Cubic Feet: 0.00004/sec (0.000002 lb/sec)

Longest Duration to Vent (hr): Continuous

Vent Pressure (torr): 620

THERMAL POWER:

Peak (kW): 0.032

Average (kW): 0.030

Run Length (hr): 2

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Fits in an STS middeck locker.

Payload Mass (lb): 7.5

Payload Volume (cubic ft): 0.25

CREW:

Can the experiment be run without crew? (Y/N): N

If not, then how could it be modified to run?:

Automate 35-mm camera operation.

CONSUMABLES (give for each item):

Mass (lb): 7.5

Volume (cubic ft): 0.25

MICROGRAVITY: 1E-4

EXPERIMENT NAME: Surface Tension Driven Convection Exp (STDCE)

DATA:

Minimum Experimental Data (bits/sec): 100

Video Requirements

Resolution (lines): 200 X 200

Frame Rate (fps): 1

Percent to the ground: 5

VACUUM:

Standard Cubic Feet: None

Longest Duration to Vent (hr): None

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): 180

Average (kW): 50

Run Length (hr): 48

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 110

Payload Volume (cubic ft): 4

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): None

Volume (cubic ft):

MICROGRAVITY: 1E-6

EXPERIMENT NAME: 3AAL

DATA:

Minimum Experimental Data (bits/sec): 0

Video Requirements

Resolution (lines): 500* X 500*

Frame Rate (fps): 30*

Percent to the ground: 1%*

VACUUM:

Standard Cubic Feet: 0.05

Longest Duration to Vent (hr): 5

Vent Pressure (torr): 10

THERMAL POWER:

Peak (kW): 0.300

Average (kW): 0.280

Run Length (hr): 24

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Designed for EAC or MSL and is not flight qualified for manned environment.

Payload Mass (lb): 155.8

Payload Volume (cubic ft): 2.85

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): GN2

Volume (cubic ft): 0.05

MICROGRAVITY: 1E-6

*Estimated

EXPERIMENT NAME: Vapor Crystal Growth

DATA:

Minimum Experimental Data (bits/sec): 20,000

Video Requirements

Resolution (lines):	300*	X 500*
Frame Rate (fps):	1*	
Percent to the ground:	1*	

VACUUM:

Standard Cubic Feet: 0

Longest Duration to Vent (hr): 0

Vent Pressure (torr): None

THERMAL POWER:

Peak (kW): 0.550

Average (kW): 0.518

Run Length (hr): 336

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Designed for Spacelab rack. Needs FES to provide power and control.

Payload Mass (lb): 163.26

Payload Volume (cubic ft): 18.8

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

With minor adjustments, requires sample changeout.

CONSUMABLES (give for each item):

Mass (lb): 0

Volume (cubic ft): 0

MICROGRAVITY: 1E-6

*Estimated

EXPERIMENT NAME: Zeolite

DATA:

Minimum Experimental Data (bits/sec): 2,000

Video Requirements

Resolution (lines): 525* X 525*

Frame Rate (fps): 10*

Percent to the ground: 1%

VACUUM:

Standard Cubic Feet: 0

Longest Duration to Vent (hr): 0

Vent Pressure (torr): 1E-3

THERMAL POWER:

Peak (kW): 1.7*

Average (kW): 0.6*

Run Length (hr): 1,008

Physical:

Can the facility pass through the Space Station hatch? (Y/N): Y

Comment:

Payload Mass (lb): 400

Payload Volume (cubic ft): 18

CREW:

Can the experiment be run without crew? (Y/N): Y

If not, then how could it be modified to run?:

CONSUMABLES (give for each item):

Mass (lb): 0

Volume (cubic ft): 0

MICROGRAVITY: 1E-6

*Estimated

3. SYSTEM REQUIREMENTS

This Section contains two major items. First, commercial free flyer data downlink transmission requirements are discussed. As a result of examining these downlink requirements, it has been determined that video compression techniques would greatly reduce the downlink burden. Therefore, candidate video compression technologies are presented. The second section item is the preliminary mission scenario analyses, which were conducted to help establish commercial free flyer requirements. Groundrules, experiment facility input data, operational cases, and final results are presented.

3.1 DATA REQUIREMENTS

The experiments in this data release have a broad range of needs for telescience (also referred to as command data) and telemetry capabilities along with on board data storage. This Section will describe very briefly these requirements and will be broken down into the following categories and subcategories:

1. Telemetry Data (Section 3.1.1)
   a. Experiment Data (3.1.1.1)
   b. Video Data (3.1.1.2)
2. Telescience (3.1.2)
3. Real Time Transmission (3.1.3)
4. Data Security (3.1.4)
5. Onboard Data Storage (3.1.5)
6. Video Compression Techniques: A Review (3.1.6).

Although category six is not a requirement, it will be very apparent after the discussion in Section 3.1.1.2 that data/video compression would be system design implementation in order to accommodate a major percentage of the potential users. It also must be brought to attention that this data release is preliminary, which implies that the supporting material is incomplete and minimal engineering analysis has been done to drive out the tall poles in the data requirements. This is due to the fact that a large percentage of the experiments are in the development phase, which results in little insight on what type of experimental data will be generated and command data required.

3.1.1 Telemetry Data

The telemetry data requirements have been broken down into two categories (experiment and video) in order to quantify the requirements.

3.1.1.1 Experiment Data - A major portion of the experiment data will not require more than 16 kbps telemetry (minus the video) as seen in Section 2.2 in reference to the user experiment data rate bar chart.

3.1.1.2 Video Data - Video data is required on approximately fifty percent of the RACO experiments and is typically associated with the fluids, combustion, and containerless processing experiments. The percentage of experiments requiring video data transmission to ground is roughly half of the total user video requirements (or one quarter of 64 RACO experiments). At a minimum, the average video requirements are typically 4.25 MHz bandwidth (analog), 30 frames/second, 525 scan lines/frame, and using 8 bits A/D conversion per sample based on Nyquist Criteria (2 samples/Hz) which equates to 67.2 Mb/s date rate. Special design implementation will have to be employed in order to

manage this enormous quantity of data and such techniques are discussed in Section 3.1.6. The discussion of real time video data requirements will be discussed in Section 3.1.3 and was left out of this Section for that reason.

3.1.2 Telescience

Telescience, as we have interpreted it, is the ability of an experimenter to interact with his or her experiment in real time. Because most of the experiments have been designed for Space Lab or Space Shuttle middeck which rely on fully manned operations, telescience would be a substitution for those experiment operations (requiring crew time) on commercial free flyer carriers which will be man-tended operated.

3.1.3 Real-Time Transmission

Although real-time transmission has not been clearly identified in this data release, the fact remains that a majority of the experiments will require both real time telemetry and telescience. Of those experiments requiring down link video, the data release does not specify real time because most of the experimenter's have specified a "desire" requirement. The basis for the down link video requirements comes from the fact that PIs would like to have visual feedback in order to recalibrate their experiment before the next run.

3.1.4 Data Security

The requirement for secured data comes about due to the fact that most commercial R & D projects are considered proprietary and these RACO experiments are no exception. Special security features and procedures are expected to be provided by experiment carrier in order to protect the experimenter's proprietary data.. This can typically be handled in the following encryption techniques (just to name a few):

1. Transposition ciphers - scrambles the characters of the message according to some rule.

2. Substitution cipher - replaces one character with another, but leaves the message in proper order.

3. Bit Manipulation - alters the computerized representation of data by some algorithm.

3.1.5 Onboard Storage

On board storage requirements will be required of a experiment carrier because of the limitations of the data transmission system. The biggest requirement is for the capability of removable media (magnetic tape, compact disks, etc.). Another requirement becomes obvious and is that a data buffer will have to be sized to accommodate the down link data and video storage requirements so that pertinent information will not be lost.

3.1.6 Video Compression Techniques: A Review

Based on the user video transmission requirements, there has been a need to investigate video compression techniques in order to identify viable solutions. This Section describes very briefly several techniques that could provide solutions in making use of the limited bandwidth available to the users.

It comes out of necessity to determine the optimum technique or techniques to get the best performance out of a constrained transmission system. In general, straightforward digitization of a broadcast television signal requires about 100 Mb/s (Ref 1) (refer to reference list at the end of this Section). The ultimate goal in the design of a video compression system is obviously to minimize the bandwidth requirements that allows the transmission of a specified acceptable picture quality. All research efforts are toward finding efficient image coding methods and the implementation of these coding algorithms with relatively inexpensive, compact, and high-speed very large scale integrated (VLSI) circuits.

Video compression processing can be divided into two broad classes-- intraframe and interframe coding. Intraframe coding is used to remove redundancy in single-frame images. Interframe coding takes advantage of the stored correlation in video frame sequences to reduce the picture redundancy between frames. For scenes with high motion, there is less correlation between the present element (pixel) and the previous frame pixel. Thus intraframe coding performs better than interframe coding. For scenes with little motion and little detail, usually interframe coding is better than intraframe coding (2). Both coding processes should be used together to achieve the highest compression ratio.

The following video compression techniques that will be discussed in this Section are:

1. Predictive coding
2. Transform coding
3. Linear Predictive coding
4. Hybrid Transform/Predictive coding
5. Conditional Replenishment coding
6. Motion Detection and Compensating coding
7. Human Visual System Model and Image Processing.

All the above techniques can be applied to either intraframe or interframe coding with the exception of transform coding, which is suitable for only single frame coding (i.e., intraframe coding).

1. In Predictive image coding, the intensity of each picture element (pixel) is predicted by the previous scanned pixels according to some algorithms. The difference

between the prediction and the actual pixel value is quantized and coded for transmission. At the receiver, images can be reconstructed from the quantized difference signal (received from the transmitter) and a prediction performed at the receiver using the same algorithm. An image compression is achieved by coarsely quantizing the difference signal (3). This coding technique takes advantage of the picture signal statistics on one hand and of the observers perception on the other for reducing the bit rate. It is the earliest coding technique developed for video compression.

The concept of differential pulse-code modulation (DCPM) was originally patented in 1952. DPCM coding system differences of successive pixels are quantized and transmitted. By combining a linear predictor with a non-uniform quantizer tailored to the observer's perception was developed. Based on the previous development, one of the most effective extension of DPCM is the use of two-dimensional spatial predictor. This results in an improvement in picture quality and further improvement can be made by combining DPCM and any adaptive quantizer. The adaptive contour prediction technique can improve the SNR by about 3.4 dB (4).

Research on Predictive coding for color video signals generally use two basic coding schemes for compressing color television signals -- component and composite codings. In composite coding, the composite color television signal, which consist of the luminance signal and the modulated subcarrier of two chrominance signals, is encoded as a single signal. In component coding, three components of a color television signal (the luminance signal and two chrominance signals) are encoded separately. The idea of incorporating the psychophysical-based human visual system into a component encoding process for color video images was used. An average bit rate of 1 bit/pixel with fair image quality was achieved by this technique.

For small types of video frame sequences, a three-dimensional spatial, nonlinear predictor can probably be used to reduce the redundancy in television signals. This type of predictor is relatively insensitive to image statics. Errors in the input of the predictor decay rapidly with time. Although very little work is published in this field, it will probably show promise for video conference applications.

2. The purpose of Transform coding is to convert statistically- dependent picture elements (pixels) into an array of relatively independent and information-compacted transform coefficients. Those coefficients are then efficiently quantized and coded for transmission. Using this technique, a unitary transform is applied to an entire image or repeated to many identical subsections (blocks) of the image. With this transform coding, higher image fidelity reconstruction is achieved at low bit rates. Also, it is insensitive to variation in image statistics and channel-error effects. This began with Fourier image

transform (5, 6), and later on came many other transformations, such as-- Hadamard transform (7), Karhunen-Loeve (K-L) transform (8), and discrete cosine transform (DCT)(9, 10, 11). Among those techniques, theoretically, K-L transform gives the best performance, but inherent computational complexity prohibits it from practical use. But because of the trend of computer technology it is becoming more feasible. The performance of discrete cosine transform is approaching K-L transform but with much more computational simplicity.

3. Linear Predictive Coding (LPC) methods have been utilized in speech(12, 13). Through an extension of the LPC method, efficient compression algorithms were devised for digital images. Using the methodology of utilizing LPC in speech processing, the LPC approaches were 2D lattice-filter prediction, adaptive quantization, and entropy coding to the imagery compression. The results of this technique showed that the 2D lattice-filter prediction provides minimal linear predictor parameterization with efficient computation and sorted for data compression application. This powerful technique, seldom used in video processing, has been applied to medical images and shows great promise.

4. Hybrid transform/Predictive coding was first introduced in 1974. This method was brought about due to the fact that, compared to Predictive coding, transform coding gives a better performance with a smaller mean-square error on reconstructed images. But transform coders are more complicated to implement than Predictive coders. With this in mind, research has extended some efficient intraframe coding techniques to include interframe coding techniques (14, 15, 16). The hybrid coder that was developed uses a one-dimensional unitary transform coder cascaded with parallel DPCM coders. Adaptive versions have been developed while one used fixed-rate feedforward adaptive hybrid to achieve bit rates of 1 to 2 bits/pixel and the other developed a line- adaptive hybrid coder, a fixed-rate feedforward adaption of DPCM encoders (17). The DPCM encoder is adapted to both the encoded line and the coefficient prediction with an achievable code rate being 1.07 bits/pixel. The hardware complexity will limit this algorithm to only limited applications. Overall, by combining two-dimensional intraframe transform coding with interframe prediction coding, good image quality can be obtained at rates as low as 0.25 bits/pixel.

5. Conditional Replenishment coding takes advantage of the fact that in real video scenes, many pixels in certain regions (such as background scenes) remain unchanged from frame to frame much of the time. In this technique the first video frame is stored at the transmitter and transmitted to the receiver as a reference frame. Each subsequent frame is then compared to the reference frame. If a pixel difference exceeds a predetermined threshold value, the old pixel is replaced by the new pixel in the reference frame at the transmitter. This new pixel is also transmitted, along with its address, to replace the old

pixel at the receiver. Replenishment techniques used for video compression include dot-by-dot and line-by-line replenishment and frame reputation (18). With this method, only a fraction of the total picture information is replenished during each frame period. Assume the replenishment ratio is N:1, a picture is built up at the receiver by using the originally stored frame and by every 1/N of the total number of samples in a frame being sent successfully in one frame period. Therefore, only 1/N of the samples in every frame are new, and the rest are old. In the moving area, some pixels show different field images, which appear as granular noise. However, no impairment was observed in the stationary area.

Instead of a pixel in the dot-by-dot replenishment, the replenishment unit is a line-by-line replenishment method. In the moving area, comb- like noise impairment can be observed. But no impairment is observed in the stationary area.

Only every Nth frame is displayed on the monitor and stored in the memory. This frame is then repeated (N-1) times on the monitor. During the time the frame is being repeated, no pixel is refreshed. Therefore, smooth movement is converted into jerky movement in N frame period. In earlier work on picture-phone activity (19), on the average, less than 10 percent of the pixels changed between frames by amount exceeding 1 percent of the peak signal. Since the replenishment information occurs at a random rate, buffers are used to redistribute the information to the communication channel at a uniform transmission rate. A dynamic threshold, which determines the occurrence of a significant change in the picture information, is varied as a function of the amount of information stored in the buffer.

With low-resolution monochrome videotelephone images with 1-MHz bandwidth, frame-replenishment coding degradation can be made negligible for conferencing application at bit rates of 1.5 Mb/s (20). For medium- resolution monochrome video images with 4-MHz bandwidth, good results were obtained at bit rates or 1.5 Mb/s(21). Coding distortion is detectable at this bit rate, but subject evaluations showed that this is acceptable for interpersonal communications. For broadcast NTSC color signals, good results have been obtained by sampling the composite signals at three times the color frequency with 22-Mb/s bit rate.

6. Motion detection and compensation coding techniques is the ability to send only the motion information through the channel. As with television signal, scanning a scene 30 times a second contains a significant amount of frame-to-frame redundancy. In this technique the picture is segmented into two parts--the background (which consist of pixels having intensities similar to those of the previous frame pixels). Information is transmitted only about the moving area in the form of prediction errors and addresses of the moving

area pixels. This scheme can be improved by estimating the displacement of objects in the scene and using the displacement estimate for Predictive coding by taking differences of elements in the moving area with respect to approximately displacement elements in the previous frame. These adaptive schemes, which are referred to as motion compensation coding schemes (22), depend upon the following:

- The amount of purely translational motion of objects in a real television scene
- The ability of an algorithm to estimate the translation with an accuracy that is desirable for good prediction of intensity
- Robustness of the displacement estimation algorithm when amplitude, spatial, and temporal resolution of the transmitted picture are lowered due to buffer fullness.

Most of the motion compensated methods have reached a bandwidth of 1.5 MHz. The two types of interframes motion compensation techniques, where the motion of each pixel of a new frame (or a group of frames) is predicted from the information available in the previous frame, are the pixel-recursive algorithm and the block-matching algorithm.

The pixel-recursive algorithm can track complex motion, such as rotation and translation, better than the block-matching algorithms. This is because, on an individual basis, pixel motion in the interframe interval can be viewed as strictly translatory in nature. However, from the viewpoint of implementing hardware for real application, the block-matching algorithms lend themselves to easier implementation.

The transform domain interframe DPCM Predictive coder, which takes advantage of human psychovisual response, allows greater coding degradation, thus a reduction in bandwidth, in those areas of the picture where human visual sensitivity is low (moving objects) and reproduces more accurately those areas where human visual sensitivity is high (uncovered background).

The 1.5 Mb/s interframe code was achieved by NEC Corporation using an improved block-matching algorithm that gives good quality for very active pictures.

In order to achieve a bandwidth of 56 Kb/s, it is necessary to use all of the known methods of compression video: skipping frames for transmission, transmission of only the difference between the new frame and the last one, and by eliminating redundancy within a single frame and multiple frames. As apart of the motion detection and compensation technique, a picture windowing technique is used to obtain as a subset of the entire picture were motion or pixel change has been detected. This windowed area will be of much higher picture quality (high resolution) with respect to the rest of the picture. The idea is when pixel change has been detected only in a certain area, the imaging system zooms up on the area of interest while still monitoring the entire FOV but only transmits pixel

information on the zoned area. The results is the image sensor dedicates a major portion of its resolution capability to only the area of interest and then transmit that information.

7. Many mathematical models of the human visual system have been researched for image processing applications (23-28). It has become clear that incorporating the human factor can significantly improve the overall picture quality. The recent increase in applying Human Visual System (HVS) models to digital image processing problems is partially due to advances on hardware technologies such as low cost, high speed, digital computers and large-scale integrated (LSI) circuits which allow the possibility of implementing increasingly more complicated image processing algorithms. Image coding or image bandwidth compression, requires a basic understanding of the HVS. For example, by incorporating the HVS model into the spatial transform coding technique, this technique has successfully compressed color images from the original 27 bits/pixel to only 1 bit/pixel. With an even better HVS model, techniques may be able to compress images at rates less than 1 bit/pixel.

Overview:

The above discussion made its best attempt to cover the entire spectrum on video compression techniques. The information has shown that currently, it appears that motion detection/compensation coding, fast discrete cosine transform coding, and hybrid transform/Predictive coding show promise for compressing TV images down to sub-T1 transmission, particularly a 56-Kb/s rate. The lack of picture quality at these rates could best be handled by incorporating human visual system models with general video compression systems.

References:

1) A. N. Netravali and J.O. Limb, "Picture Coding: A Review, " Proceedings of the IEEE, Vol. 68 No. 3 March 1980.

2) A. N. Netravali, "Image Processing for Communication, "

3) W. K. Pratt, Ed., Image Transmission Techniques, Academic Press, 1979.

4) P. Cohen and J. P. Adoul (1976), NTC, pp. 6.1.1-6.1.5

5) J. W. Cooley and J. W. Tukey, "An Algorithm for the Machine Calculation of Complex Fourier Series, " Math. Compt., April 1965, pp. 2, 971-.

6) H. C. Andrews and W. K. Pratt, Fourier Transform Coding of Images, " Proc. of Int. Conf. System Sciences, Honolulu, Hawaii, January 1968, pp. 677-679.

7) W. K. Pratt, J. Kane, and H. C. Andrews, "Hadamard Transform Image Coding, "Poc. of the IEEE, Vol. 57, No. 1, January 1969.

8) H. Karhunen, "On Linear Methods in Probability Theory, " translated from "Uber Lineare Methoden in der Wahrscheinlich- Keitsrechnung, " by I. Selin, The RAND Corp., Doc. T-131, August 11, 1960.

9) N. Ahmend, T. Natarajan, and K. R. Rao, "Discrete Cosine Transform, " IEEE Trans. on Computers, January 1974, pp. 90-4.

10) K. R. Rao, Ed., Discrete Transforms and Their Applications, Hutchinson Ross Publishiing Co., Stroudsburg, PA, 1983.

11) W. H. Chen, C. H. Smith, and S. C. Farlick, "A Fast Computational Algorithm for the Discrete Transform, "

12) J. Makahoul, "Linear Prediction: A Tutorial Review, " Proc. of the IEEE, Vol. 63, No. 4, April 1975.

13) P. Poehler and J. Choi, "Linear Predictive Coding of Imagery for Data Compression Applications, " ICASSP 83, Boston, MA 1983, pp. 1.204-3.

14) J. A. Rose, "Interframe Coding of Digital Images Using Transform and Hybrid Transform/Predictive Coding Techniques, " USCIPI Rep. 700, University of Southern California, Image Processing Institute, Los Angles, 1976.

15) J. A. Rose, W. K. Pratt, and G. S. Robinson, "Interframe Cosine Transform Image Coding, " IEEE Tran. on Communication, Vol. COM_25, November 1977. pp. 1.324-39.

16) A. Habibi, "Hybrid Coding of pictorial Data, " IEEE Trans, on Communication, Vol. COM-22, May 1974, pp. 614-24.

17) A. K. Jain, "Image Data Compression: A Review." Proc. of IEEE, Vol. 69, No. 3, March 1981, pp. 349-89.

18) I. Yoroizawa, K. Takikawa, and Y. Kobayshi, "Subjective Quality Assessment of Television Pictures Reduced Signal Bandwidth by Using Systematic Replenishments, " Review of the Electrical Communication Laboratories, NEC, Vol. 30, No. 4, 1983, pp. 689-94.

19) F. W. Mounts, "A Video Encoding System with Conditional Picture Element Replenishment, " B.S.T.J., September 1969, pp. 2, 545-54.

20) J. O. Limb, R. F. W. Pease, and K. A. Walsh, "A Video Encoding System with Conditional Picture Element Replenishment, " B. S. T. J., Vol. 53, 1974, pp. 1, 137-73.

21) B. G. Haskell, P. L. Gordon, R. L. Schmidt, and J. V. Scattaglia, "A Video Encoding System with Conditional Picture Element Replenishment, " IEEE Trans. on Communication, Vol. COM-25, No. 8.

22) A. N. Netravali and J. D. Robbins, "Motion-Compensated Television Coding: Part 1, " B.S.T.J., Vol. 58, No. 3, March 1979, pp. 631-670.

23) T. G. Stockham, "Image Processing in the Context of a Visual Model, " Proceedings of the IEEE, Vol. 60, No. 7, pp. 828-42, July 1972.

24) J. L. Mannos and D. J. Sakrison, "The Effect of a Visual Fidelity Criterion on the Encoding of Images, " IEEE Tran. on Information Theory, Vol. IT-20, No. 4, pp. 525-536, July 1974.

25) C. L. Hall and E. L. Hall, "A Nonlinear Model for the Spatial Characteristics if the Human Visual System, " IEEE Trans. on System, Man, and Cybernetics, Vol. SMC-7, No. 3, pp. 161-170.

26) J. O. Limb and C. B. Rubinstein, "A Model of Threshold Vision Incorporating Inhomogeneity of the Visual Field, " Vision Research, Vol. 17, pp. 571-84, April 1977.

27) D. J. Sakrison, "On the Role of the Observer and a Distortion Measure in Image Transmission, " IEEE Transaction on Communications, Vol. COM-25, No. 11, pp. 1251-1267, November 1977.

28) W. A. Pearlman, "A Visual System Model and a New Distortion Measure in the Context of Image Processing, " Journal of the Optical Society of America, Vol. 68, No. 3, pp. 374-386, March 1978.

3.2 SYSTEM REQUIREMENTS DEFINITION

In an initial effort to develop commercial free flyer facility requirements, 10 mission scenarios using MMPF data and 20 mission scenarios using RACO data were generated. Sixteen representative RACO facilities and 14 representative MMPF facilities were used in the respective scenarios. The scenarios were examined to establish typical data, crewtime and logistics (volume, thermal and power capacity were assumed) requirements for an MPS free flyer. The input data and results are presented in this Section.

Table 3.2-1 contains scenario groundrules and assumptions used in requirements generation. After establishing the groundrules, functional flows were developed for each facility from user data. Timelined power, thermal, data and crew requirements were generated from those functional flows. Timelines for the 16 RACO facilities are contained in Table 3.2-2. The equivalent MMPF data are contained in the MMPF data release. All timelines were reviewed to determine which activities must be done by crew and which can be done automatically. Table 3.2-3 contains the RACO results of this review. The column entitled "crew" on the table is the total of the set-up and service time. Additionally, the minimum and maximum number of runs per RACO facility were determined and are contained in Table 3.2-4. Lastly, ten operational mission cases using mission duration, beta angle and volumetric capacity as variables were established. Table 3.2-5 contains these cases. The power profiles, as a result of beta angle, are further defined in Table 3.2-6. These power variations were incorporated into the scenario runs.

The ten scenarios presented in Table 3.2-5 were repeated three times. Once, using MMPF facilities data; once, using "as is" RACO facilities data; and once, using slightly modified RACO facilities. Typical RACO hardware modifications were generally assumed to be minor automation improvements. Facility timeline data was then compared to the power, heat rejection, volume and time resources of the given cases. From this comparison, the number of experiment runs, power usage, data requirements and heat rejection usage for each scenario were established. Timeline profiles of the latter three items are contained in Table 3.2-6. Table 3.2-6 data, labeled SF-1 through SF- 10, are the results for the MMPF facilities when applied to the 10 cases contained in Table 3.2-5. Data labeled Scenarios 1 through 10 apply to the "as is" RACO facilities for the same 10 cases and data, labeled Scenarios 11 through 20, applies to the modified RACO facilities. While generating this data; power, thermal and data requirements were checked to insure that set limits were not exceeded.

Table 3.2-7 contains the tabulated results for power, heat rejection, data rates, and facility run numbers for each scenario. Consumable, sample and waste disposal requirements were established for each facility on a per run basis. These data are contained

in Table 3.2-8. The Global scenario requirements in this table were established by taking an average of the scenario SF 1 to SF 10 values. The experiment run frequency data and the information contained in Table 3.2-8 were used to generate each scenario's logistics requirements. Results of those calculations are contained in Table 3.2-9 along with power, thermal and data summaries.

Several preliminary results were obtained from the above analyses. First, the RACO facilities, as currently configured, cannot take full advantage of a free flyer facility. Secondly, reduced power as a result of a low beta angle does not appear to be the limiting factor on experiment run number. Finally, on-orbit crew requirements are approximately 112 manhours to set-up and 51 manhours to service experiments for the low capacity carrier. Approximately, 243 manhours for set-up and 93 manhours for servicing are required for the high capacity carrier.

An additional analysis conducted during this effort was to examine logistic's sample return storage requirements. Table 3.2-10 contains this data. Many of the facilities in the RACO data base produce perishable samples. To reduce sample degradation during storage and return, power must be provided continuously until access and removal is completed. There are four basic groups which are listed in the Sample Return Analysis table. Group 1 items, protein crystals, require a very low tolerance refrigeration system. Group 2 items, organic crystals, require product thermal control between 20 and 30°C. Group 3 items, biologicals, require storage at -10°C or lower. Group 4 items, electronic crystals, should be kept below 38°C.

GROUNDRULES AND ASSUMPTIONS

GENERAL

1) MPS PAYLOADS ONLY WERE CONSIDERED.
2) US PAYLOADS ONLY WERE CONSIDERED.

SET-UP

1) TWO CREWMEN WORKING 24 HOURS A DAY WERE ASSUMED.
2) PEAK POWER WAS ASSUMED TO BE 24 KW (ORBITER POWER WAS AVAILABLE TO THE FREE FLYER).
3) ONE SET-UP PROCEDURE PER FACILITY.

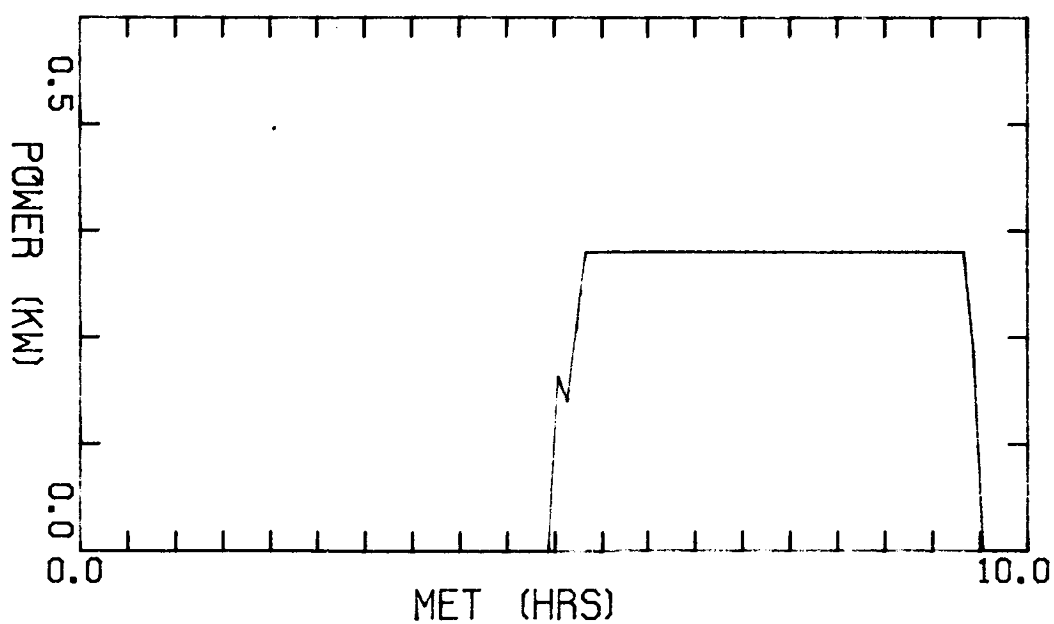
RUN

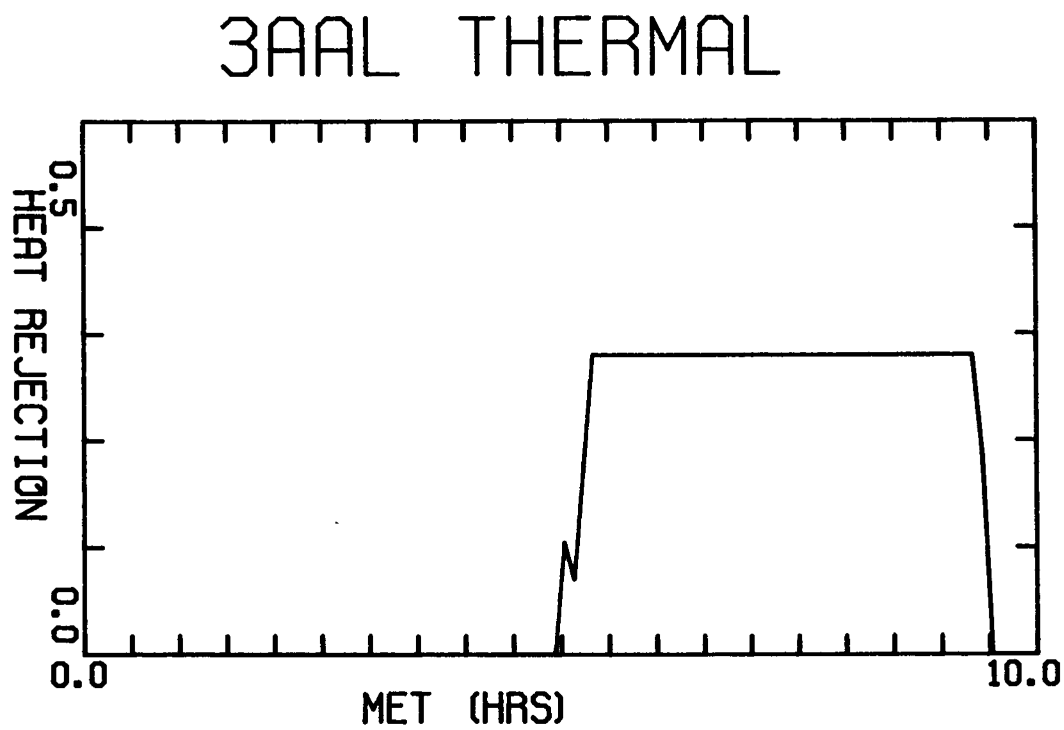
1) MAXIMUM EXPERIMENT RUN TIME REQUEST PER FACILITY WAS UTILIZED.
2) MAXIMUM POWER CAPABILITY WAS ASSUMED TO BE 10.3 KW TO THE USERS.
3) BETA ANGLES WERE VARIED BETWEEN SCENARIOS.
4) NO CREWMEN WERE AVAILABLE.
5) DATA LINK WAS LIMITED TO 64 KBPS.
6) NO LIMIT WAS PUT ON THERMAL CAPABILITY.
7) EXPERIMENT START-UP WAS 24 HOURS AFTER FINAL FACILITY SET-UP.
8) ALL EXPERIMENTS WERE SHUT-DOWN 24 HOURS PRIOR TO STS DOCKING.

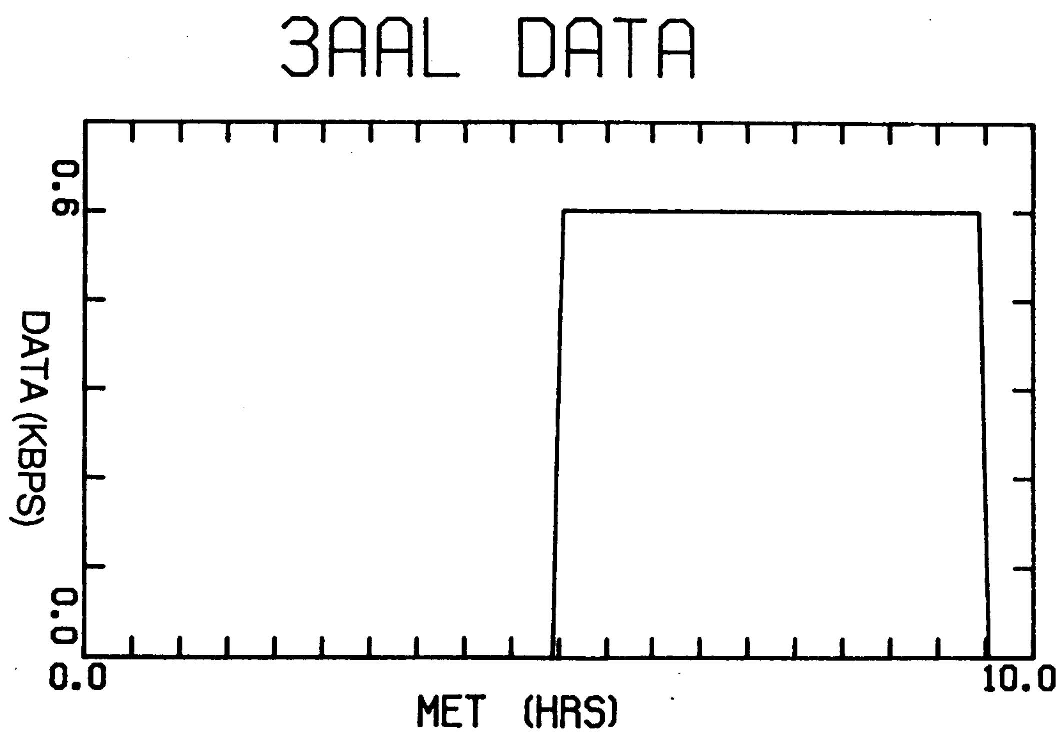
SERVICING

1) TWO CREWMEN WORKING 24 HOURS PER DAY WERE ASSUMED.
2) PEAK POWER WAS ASSUMED TO BE 24 KW (ORBITER POWER WAS AVAILABLE TO THE FREE FLYER).

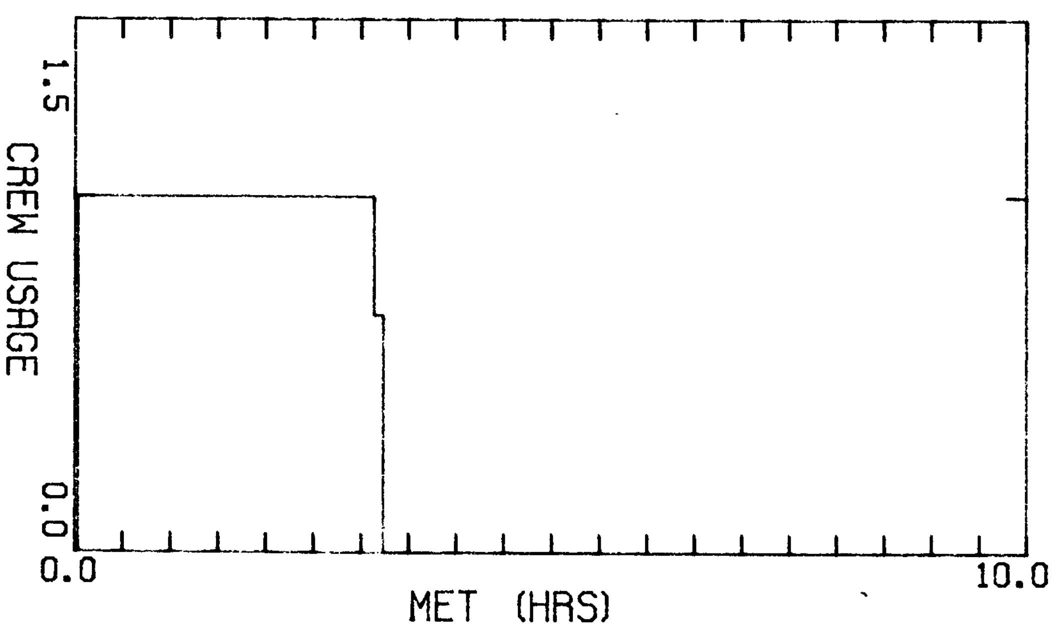
3AAL PØWER

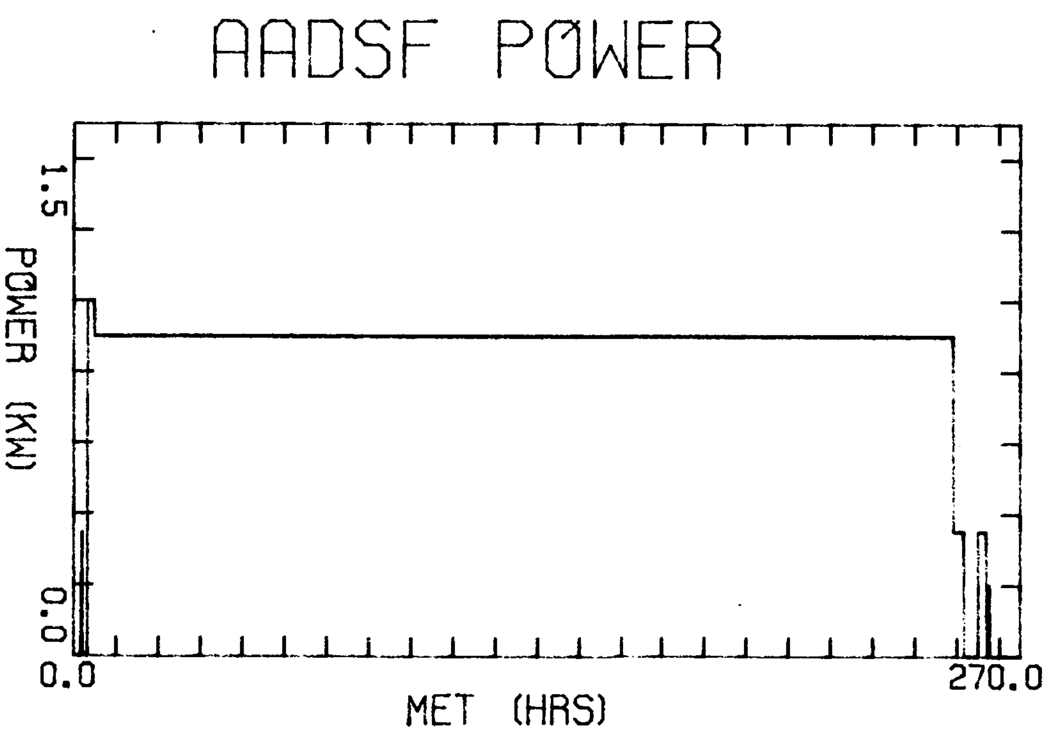



3AAL THERMAL
HEAT REJECTION
0.5
0.0
0.0
10.0
MET (HRS)

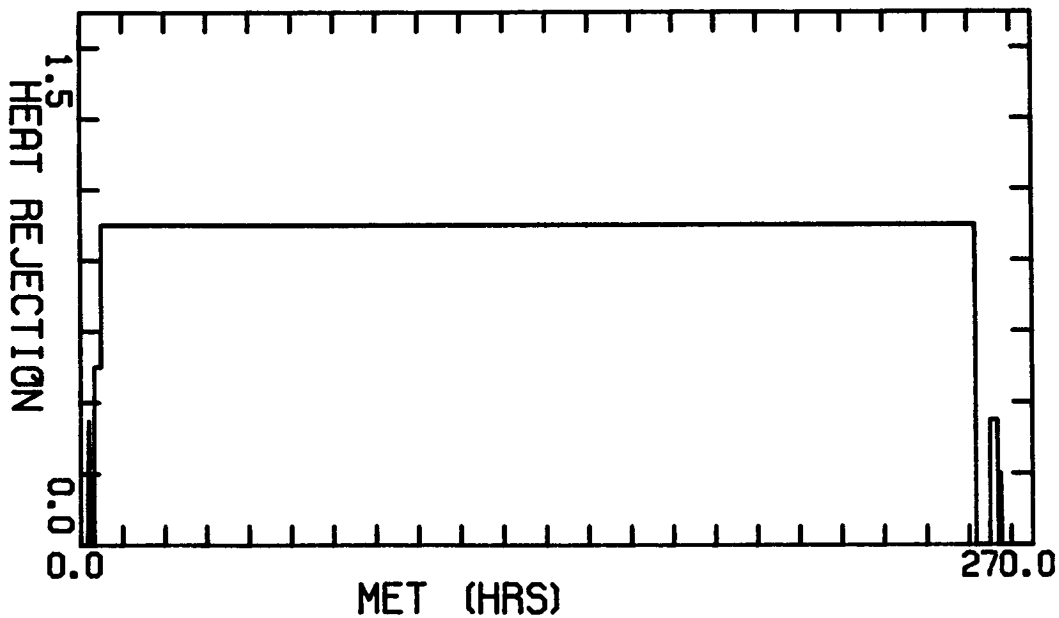

3AAL DATA
0.6
0.0
DATA (KBPS)
0.0
10.0
MET (HRS)

3AAL

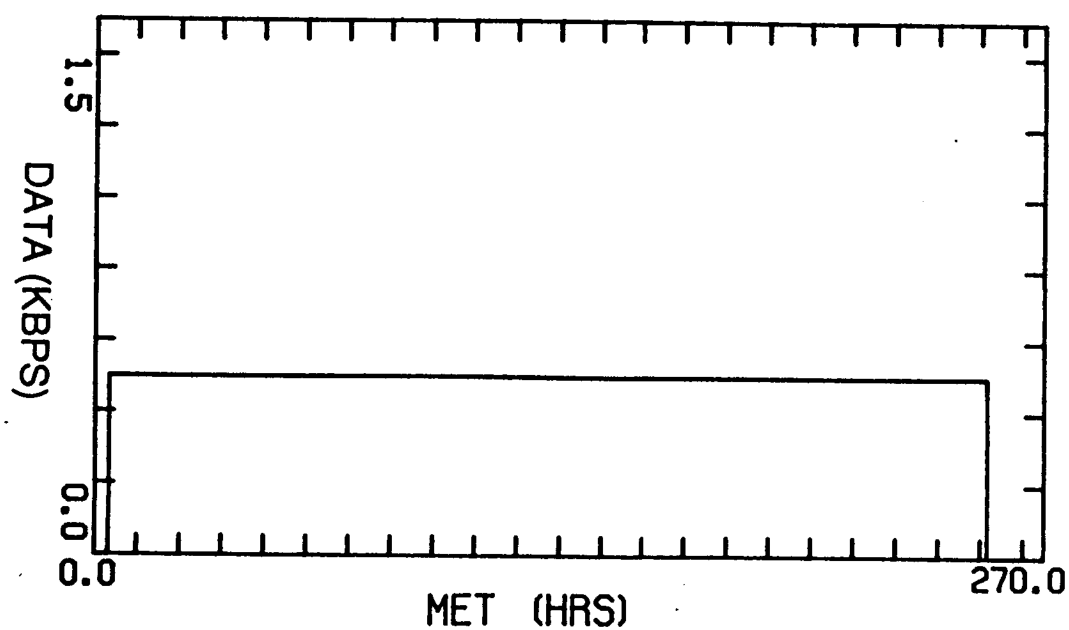



AADSF PØWER
1.5
0.0
PØWER (KW)
0.0
270.0
MET (HRS)

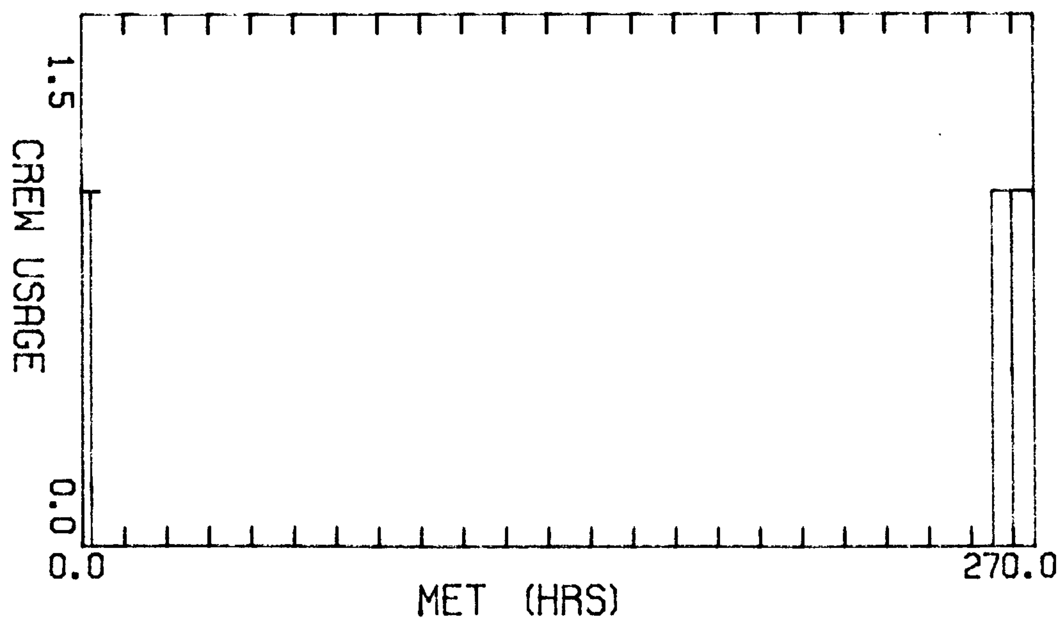
AADSF THERMAL



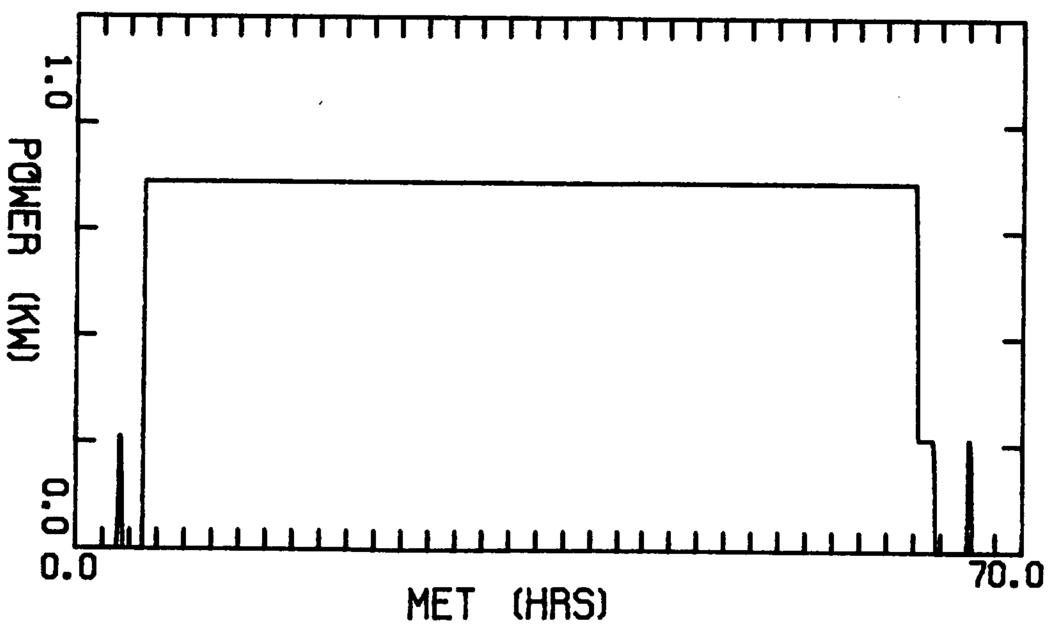
AADSF DATA



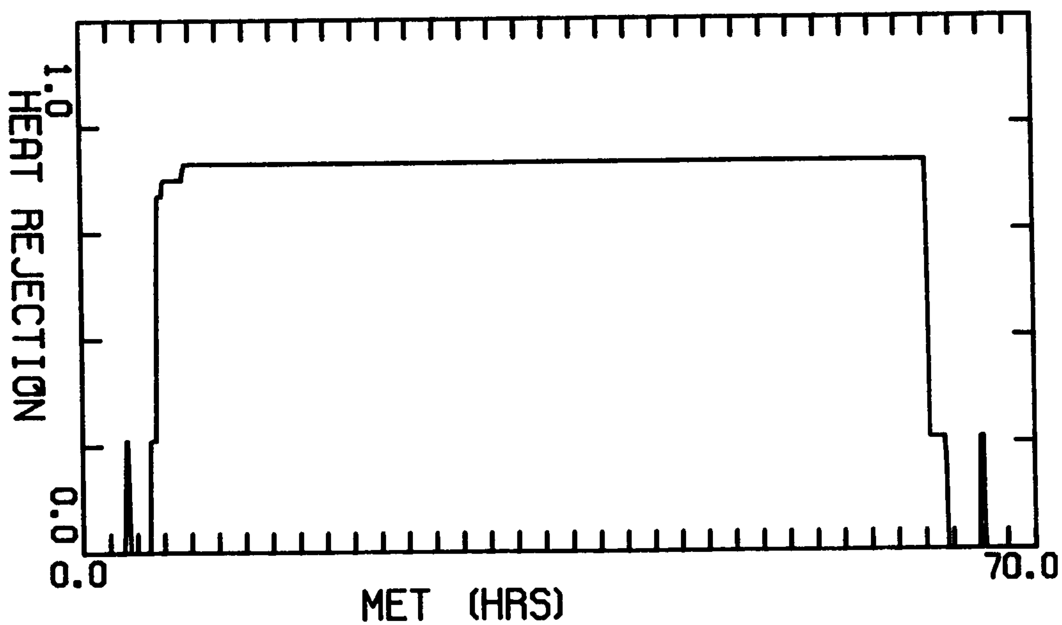
AADSF

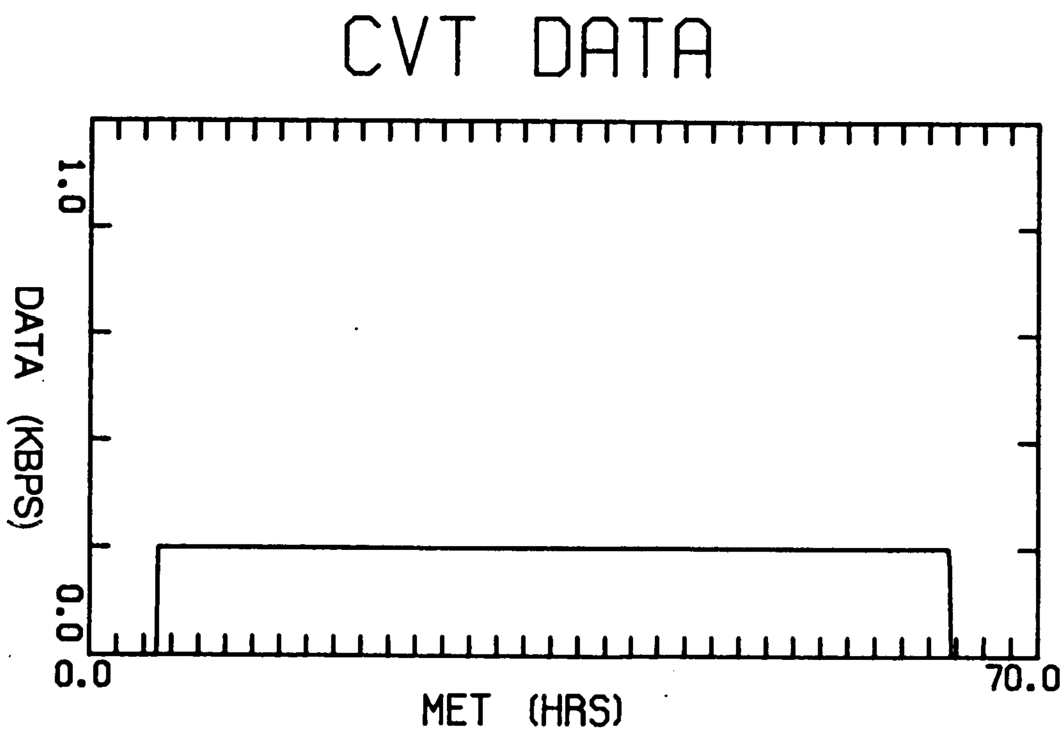


CVT PØWER

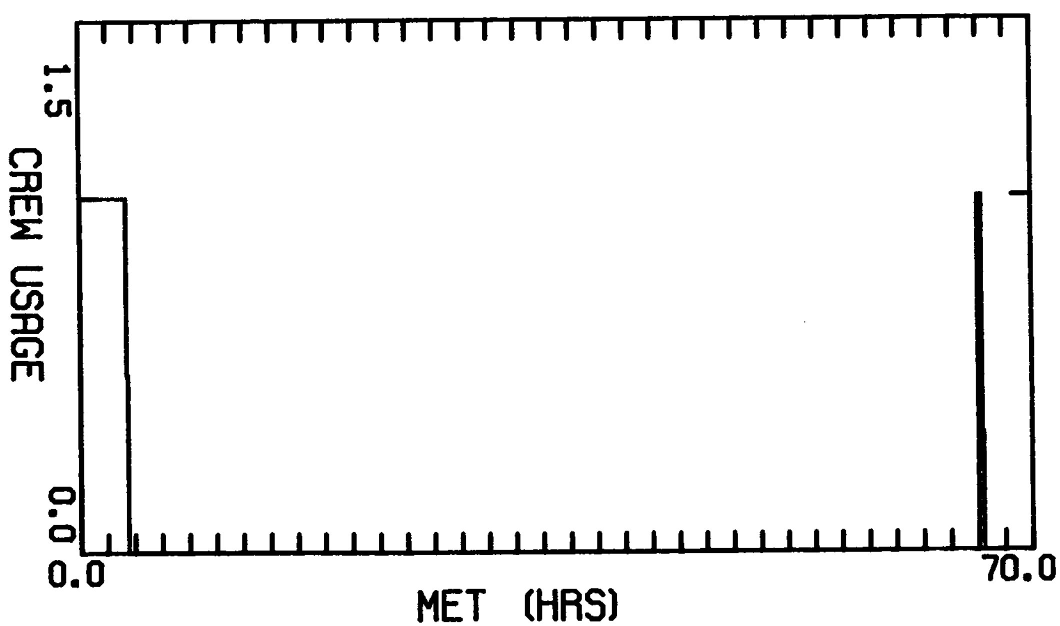


CVT THERMAL

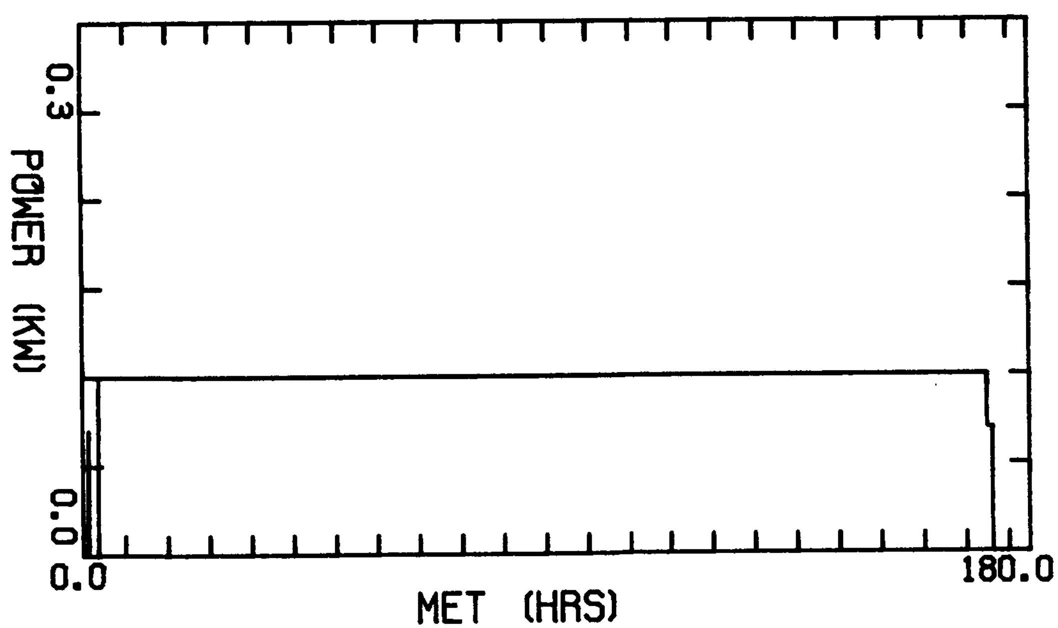



CVT DATA
1.0
0.0
DATA (KBPS)
0.0
70.0
MET (HRS)

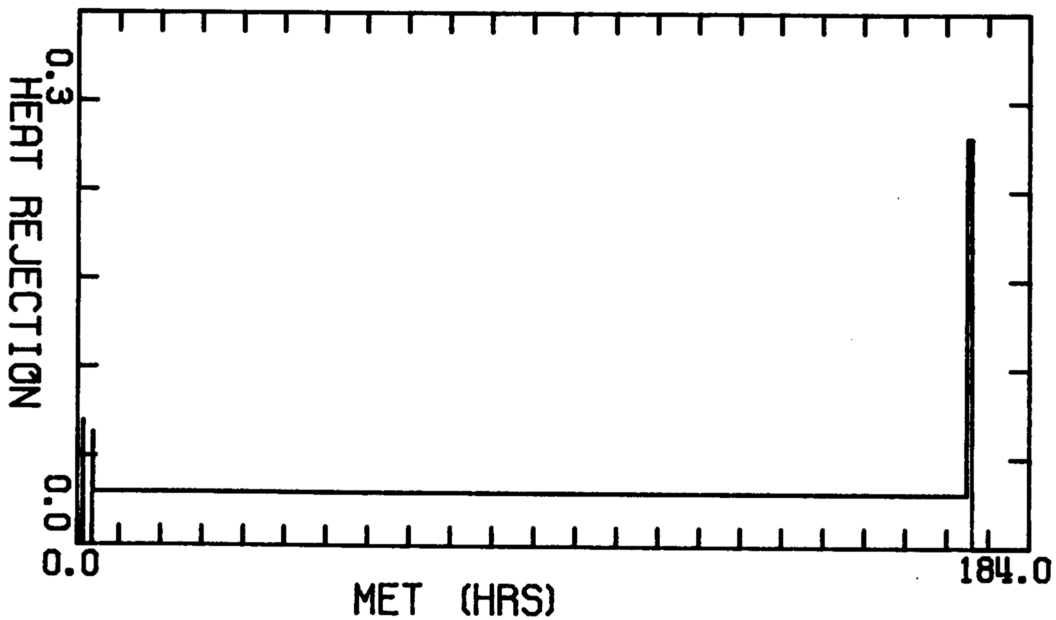
CVT



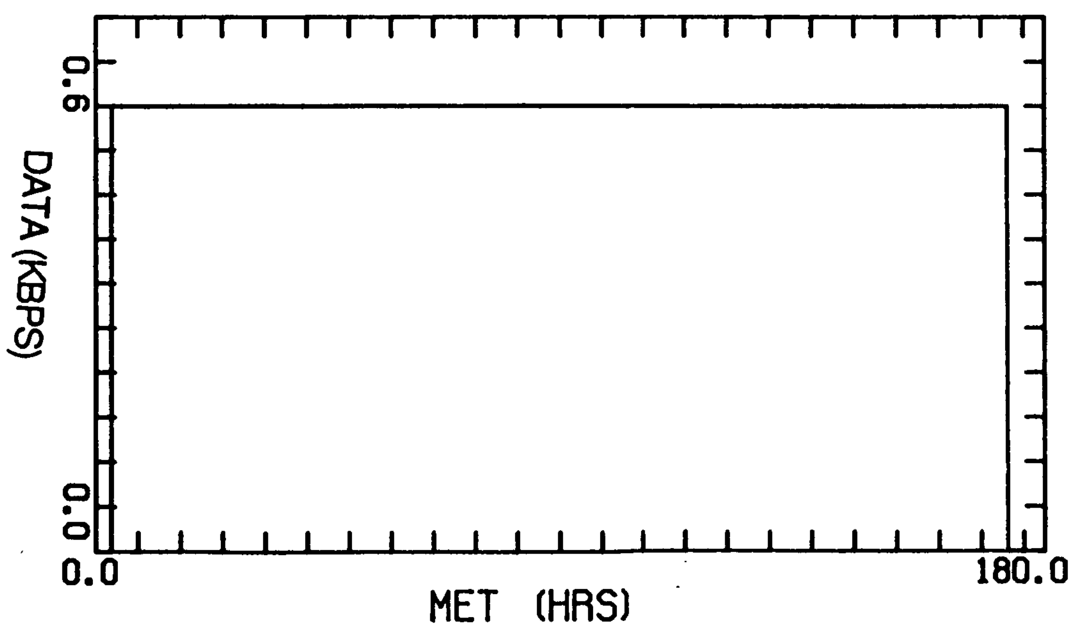
DMØS PØWER



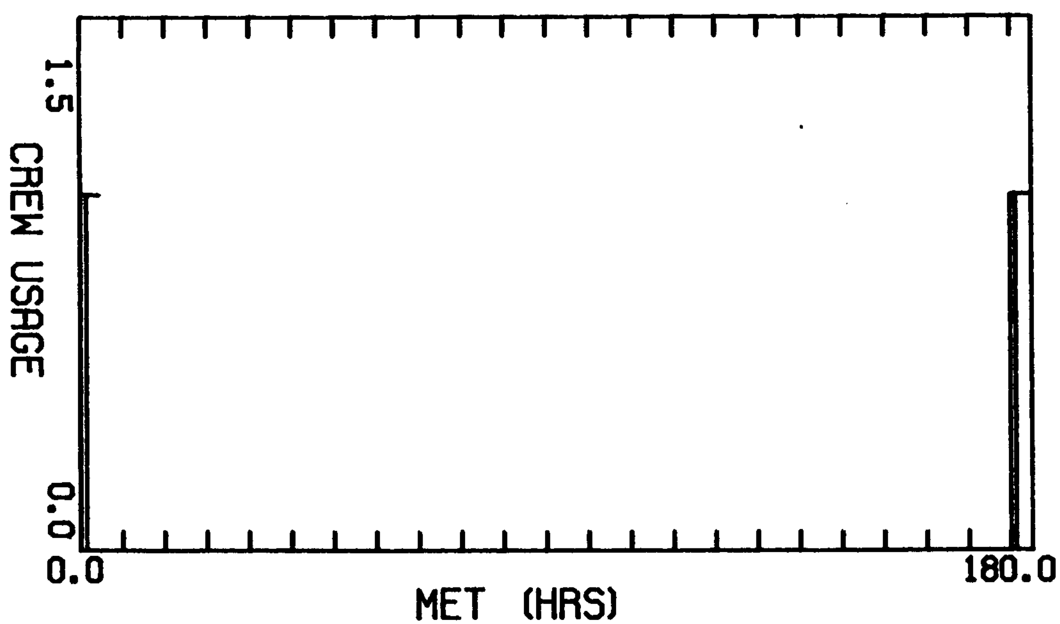
DMØS THERMAL



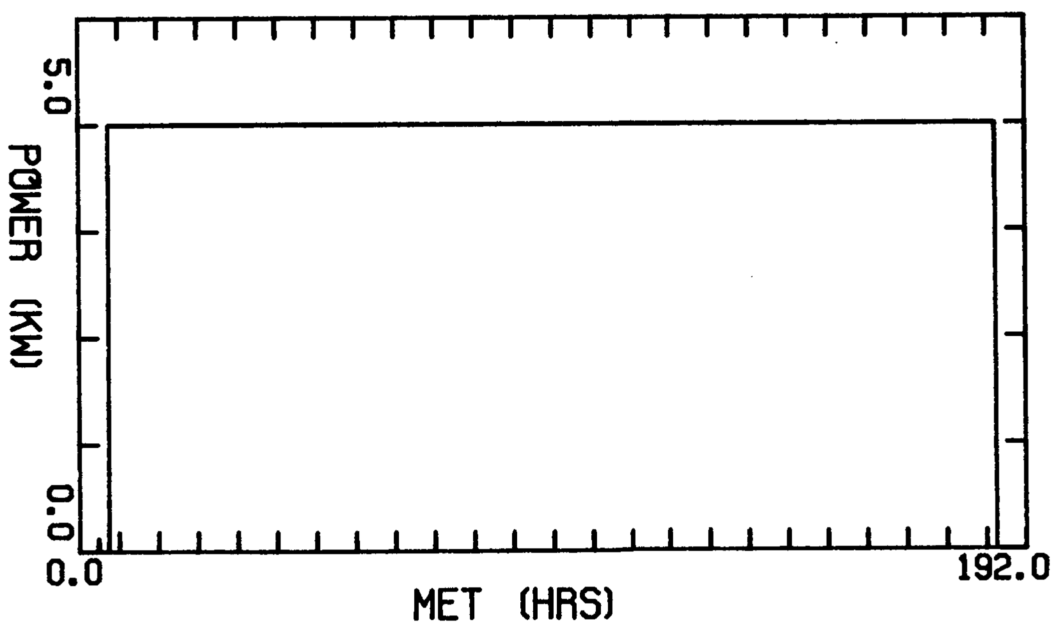
DMØS DATA



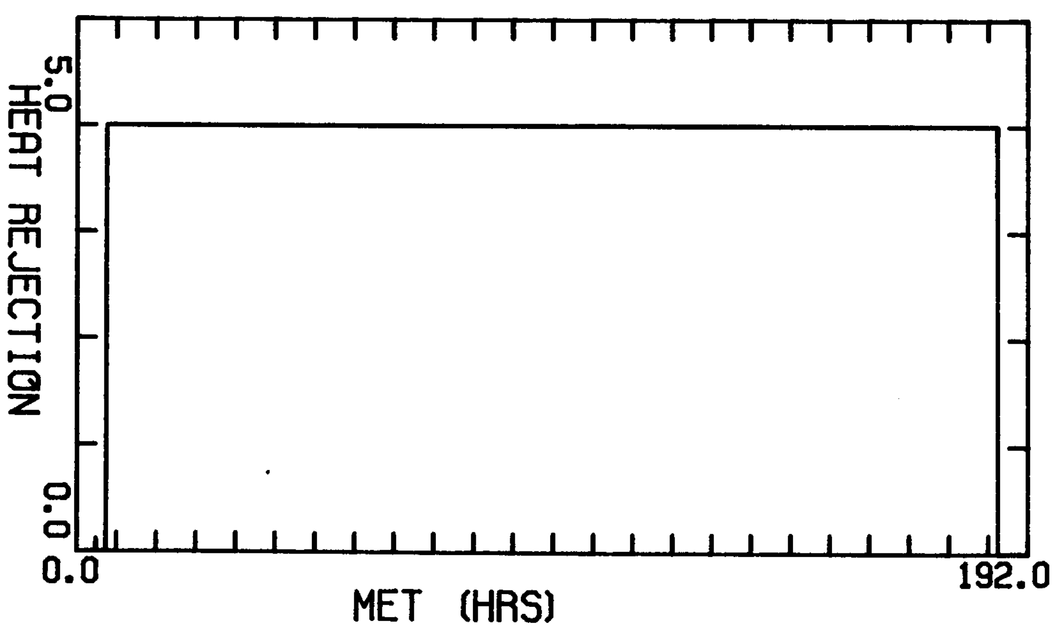
DMØS



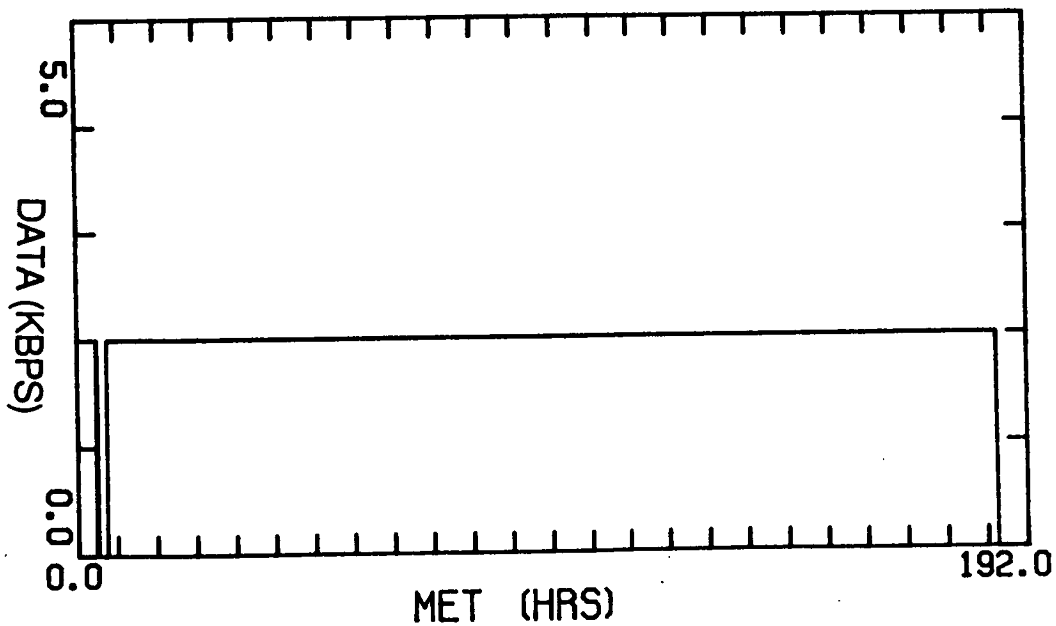
ECG PØWER



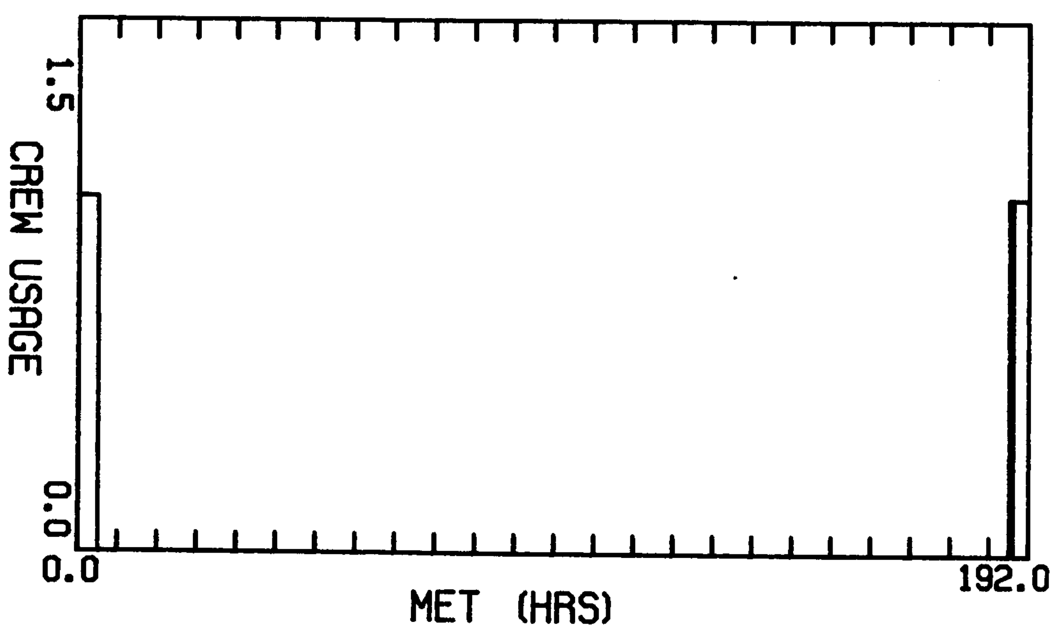
ECG THERMAL



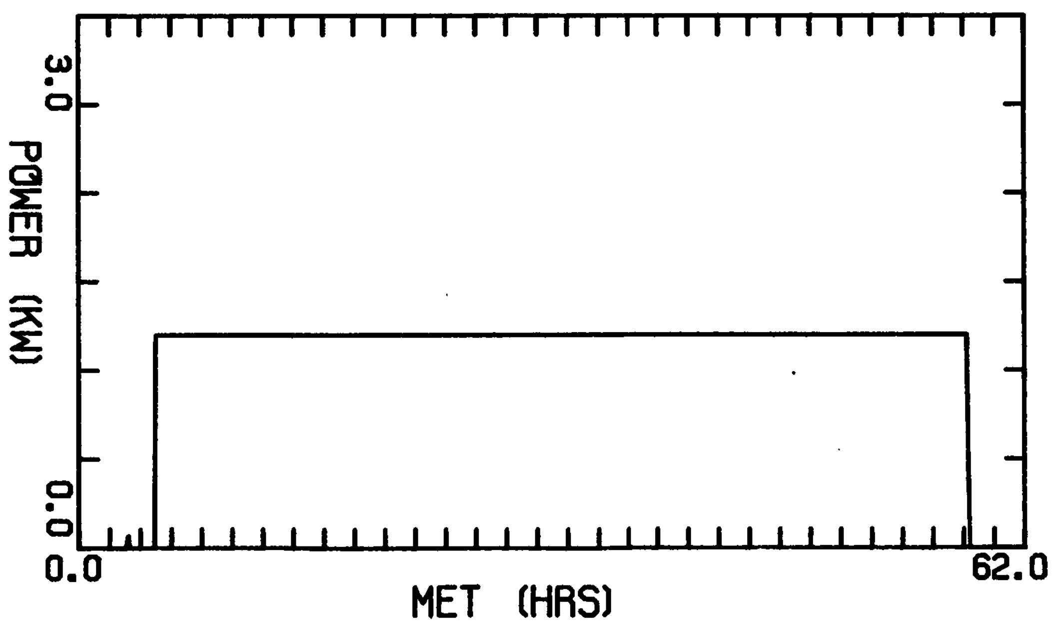
ECG DATA



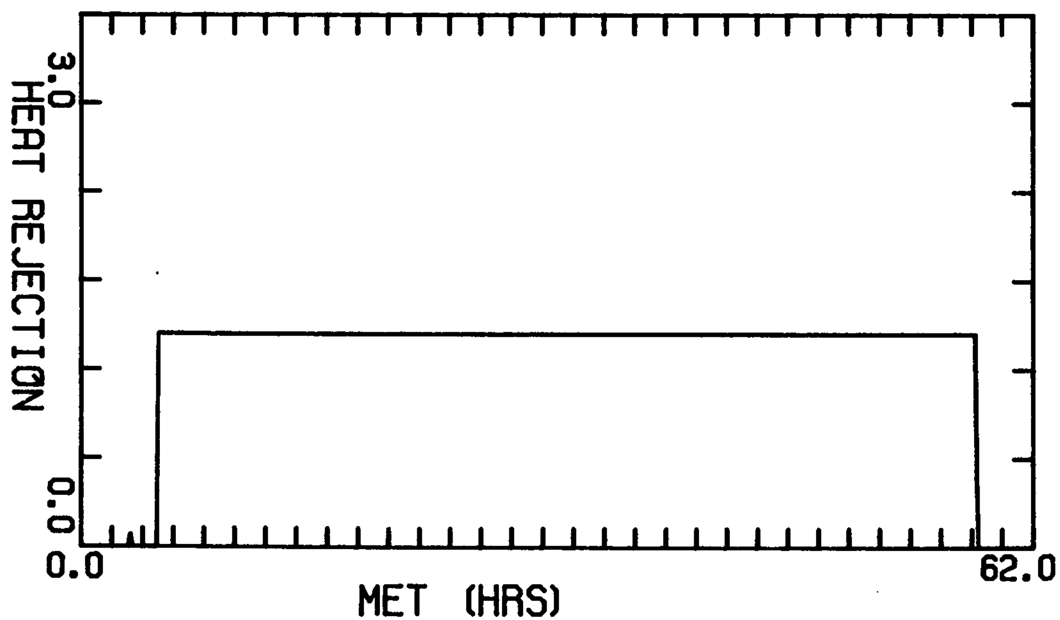
ECG

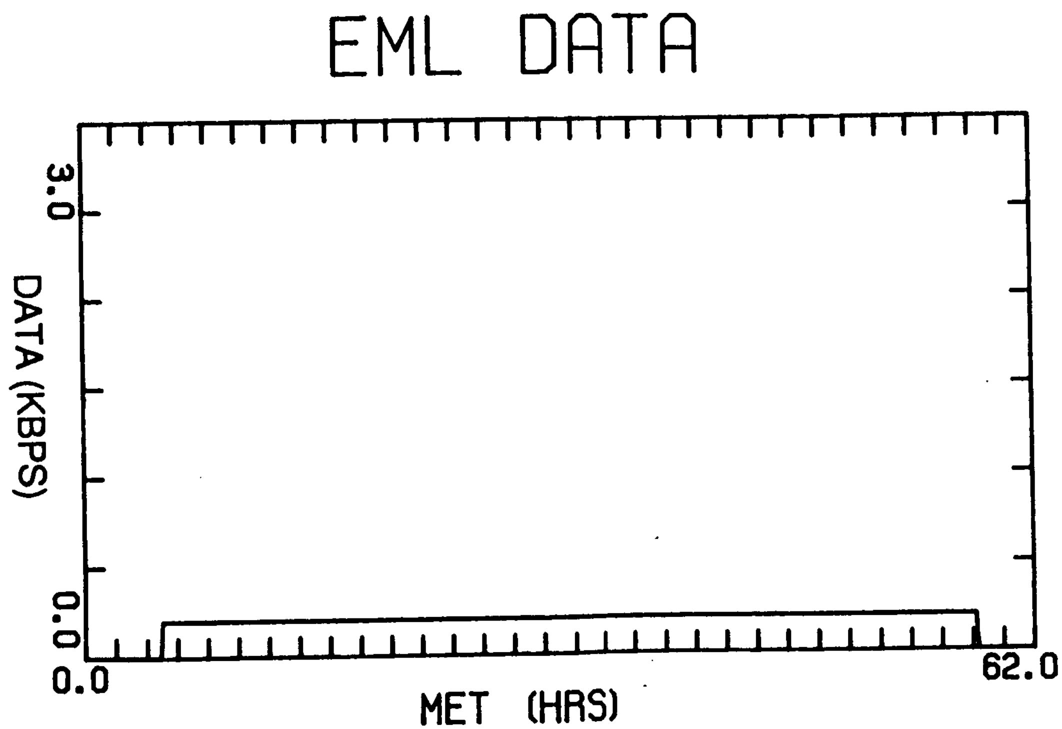


EML PØWER



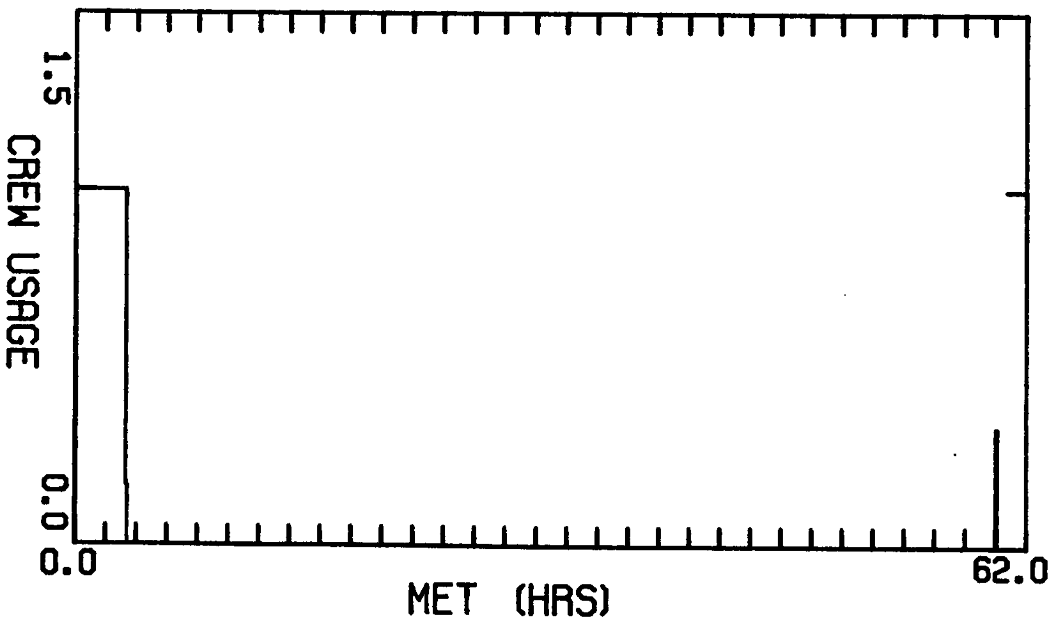
EML THERMAL



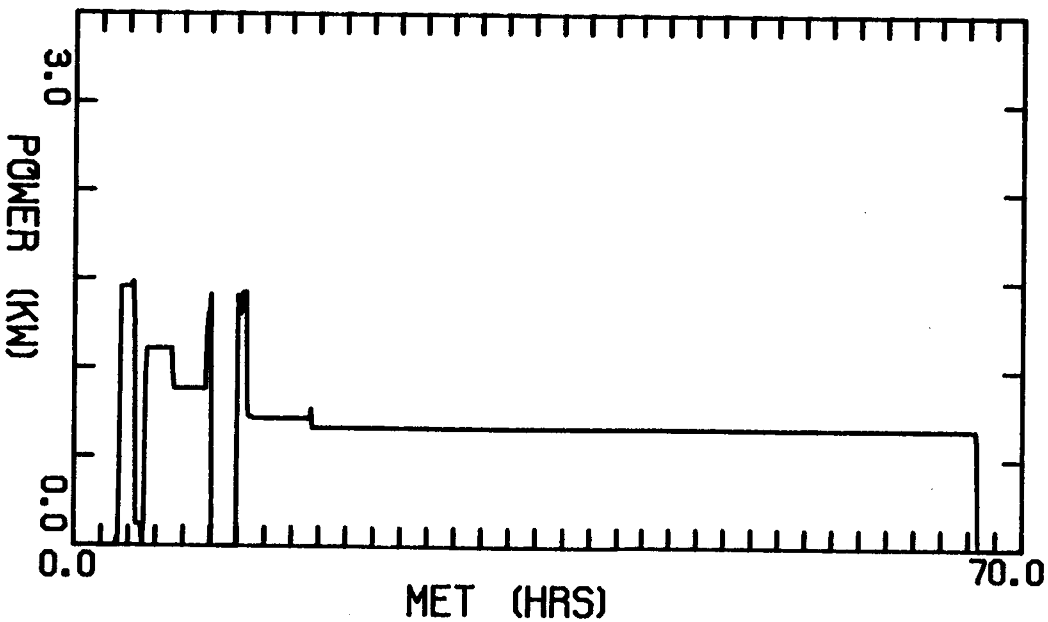


EML DATA
3.0
0.0
DATA (KBPS)
0.0
62.0
MET (HRS)

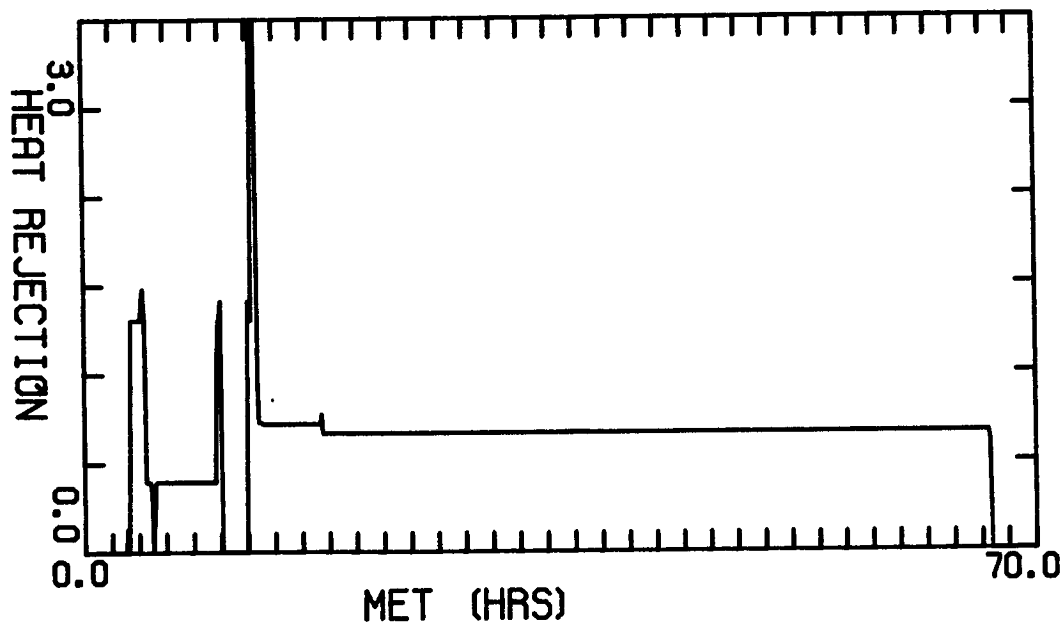
EML



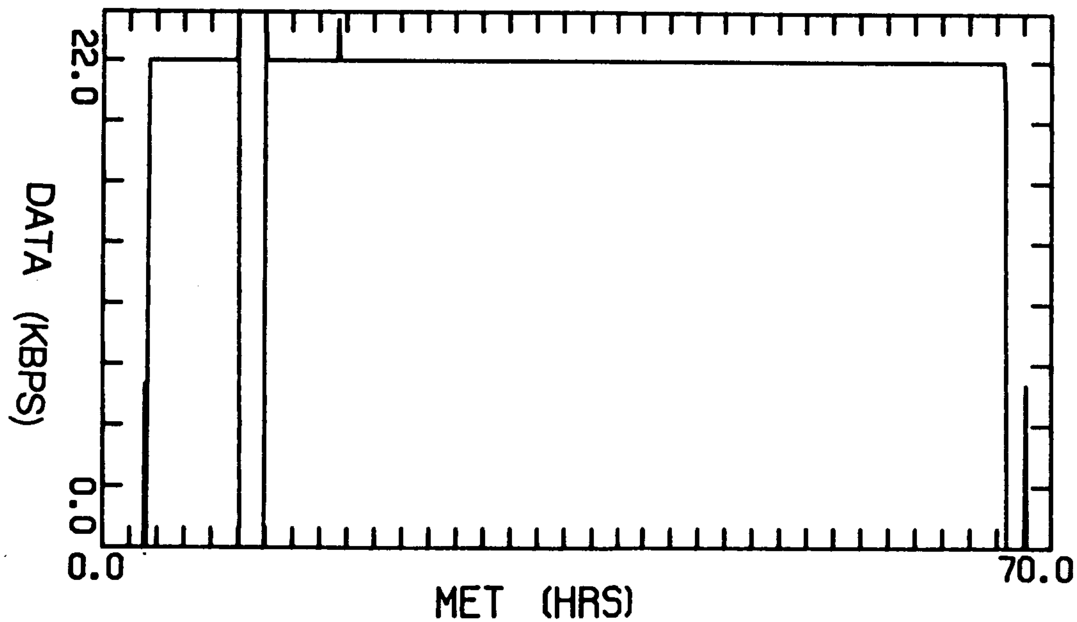
FES PØWER



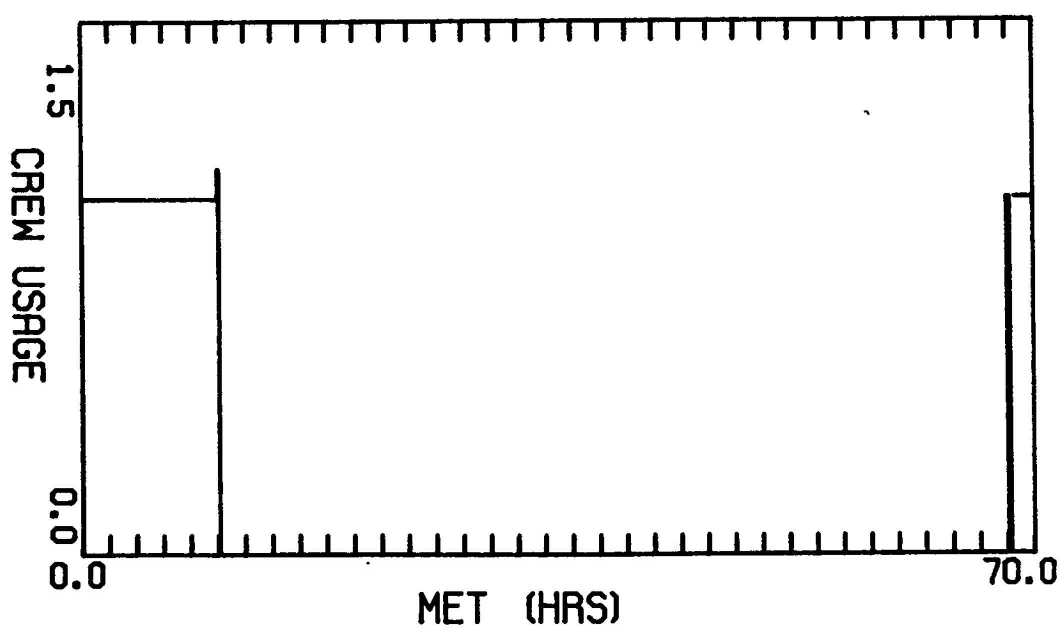
FES THERMAL



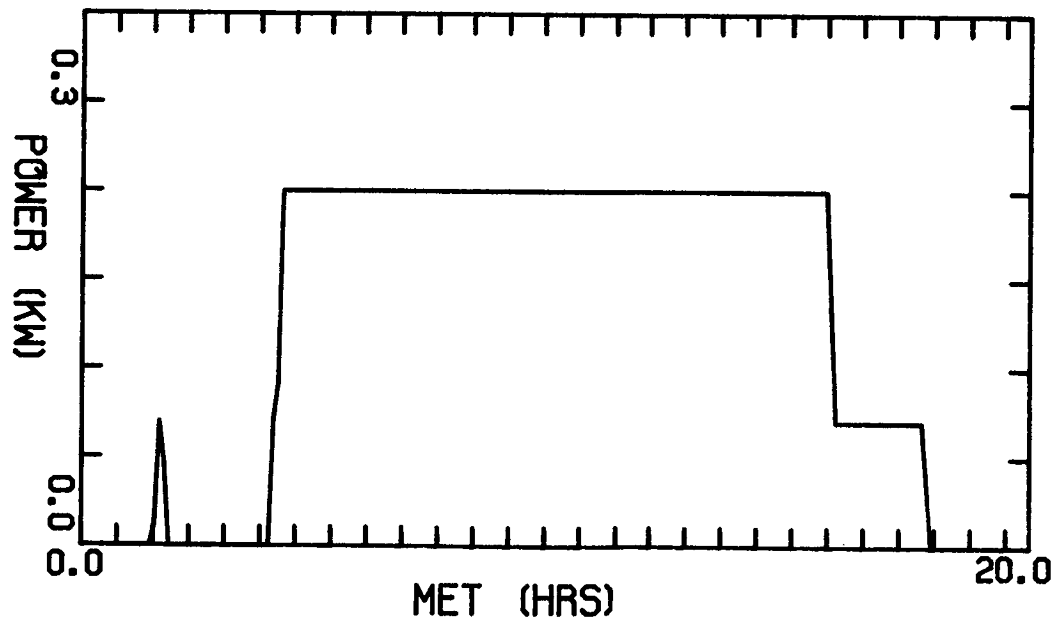
FES DATA

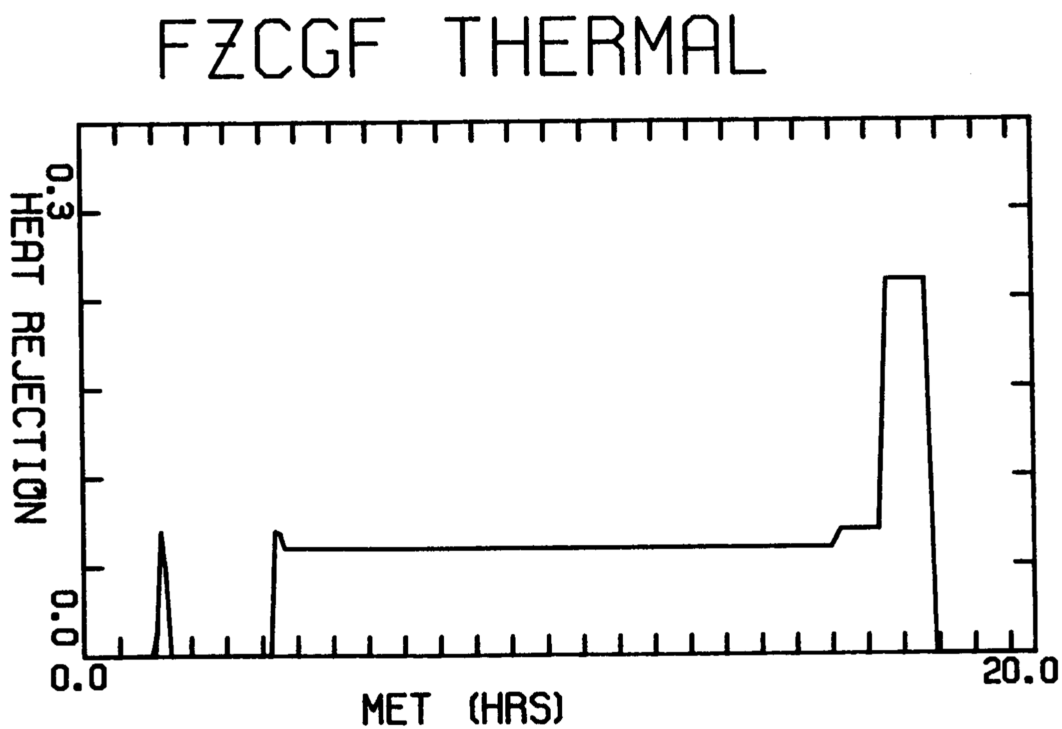


FES



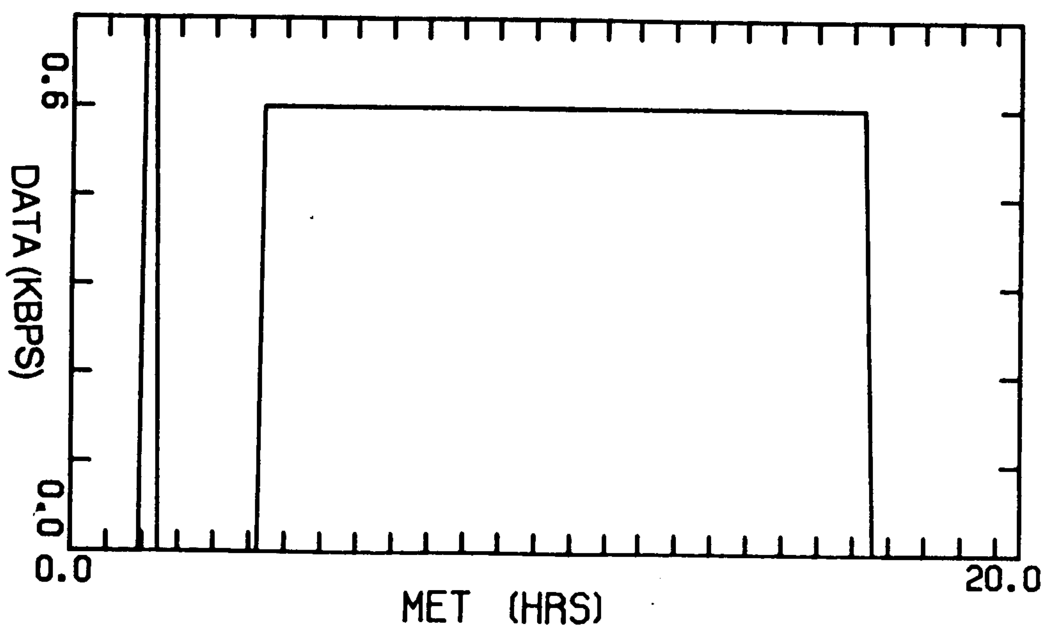
FZCGF PØWER



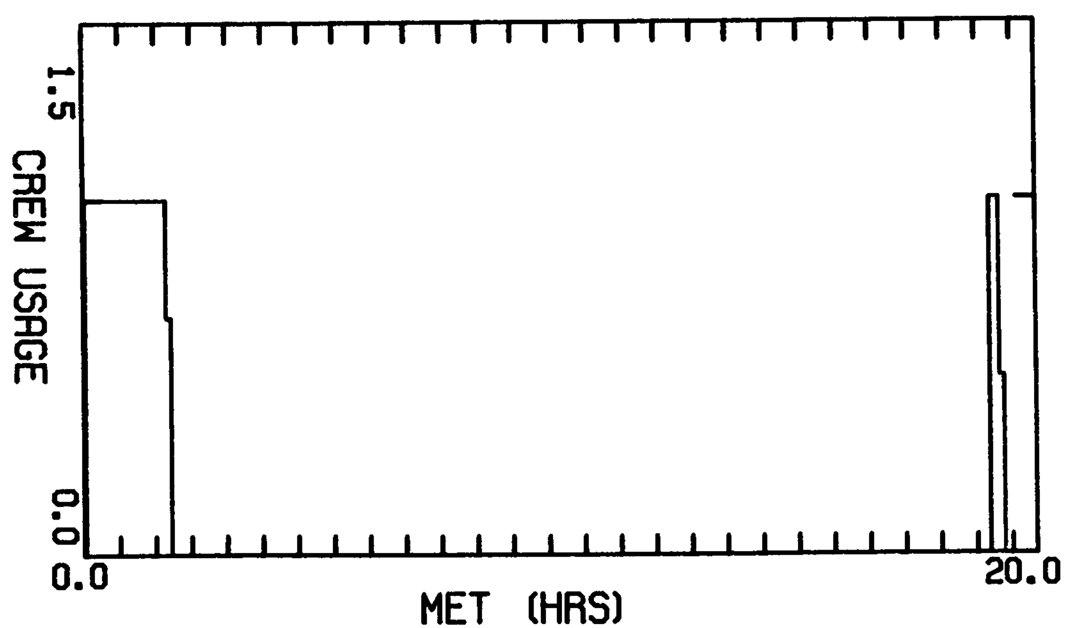


FZCGF THERMAL
0.3
HEAT REJECTION
0.0
0.0
20.0
MET (HRS)

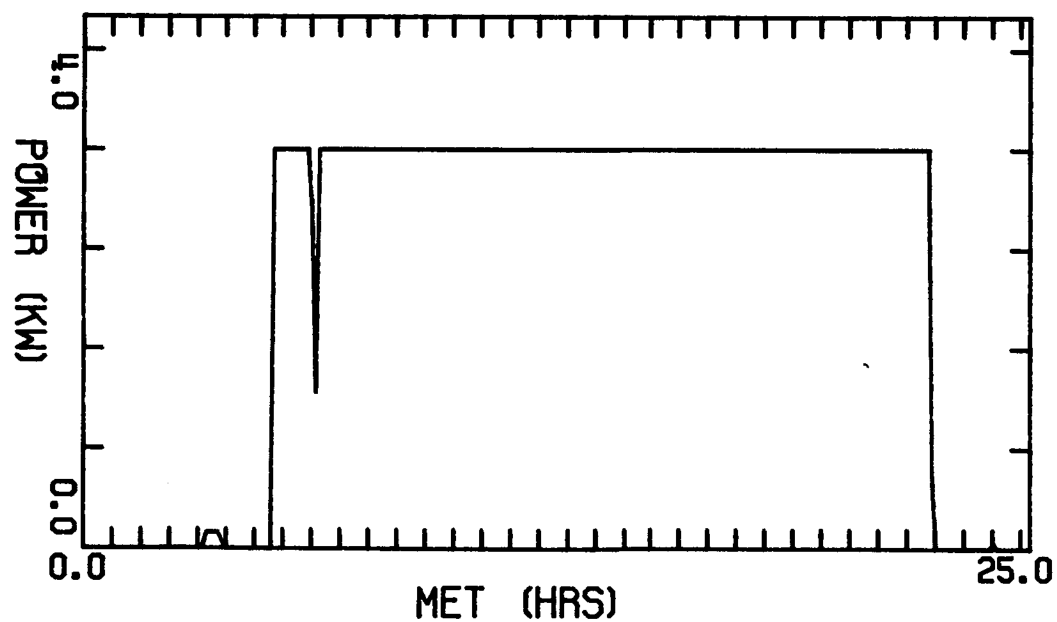
FZCGF DATA



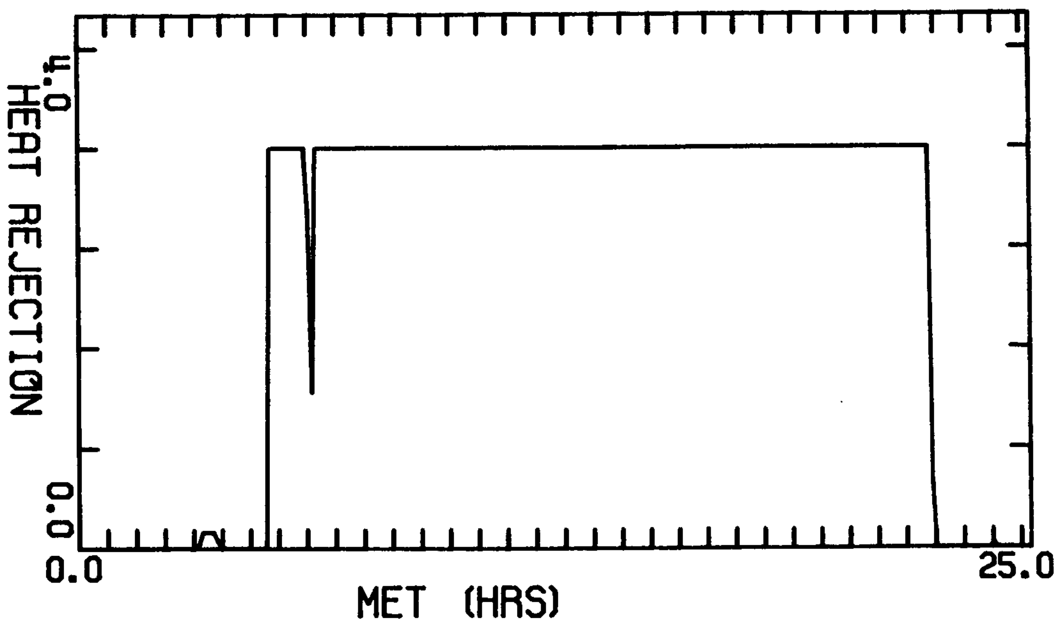
FZCGF

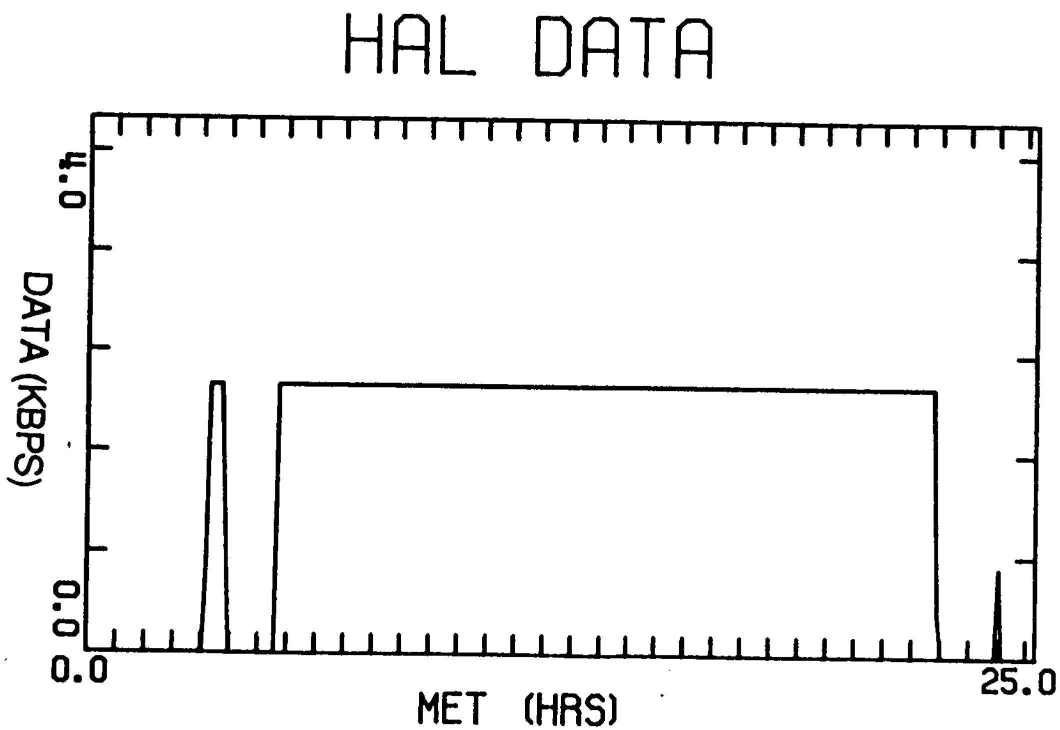


HAL PØWER

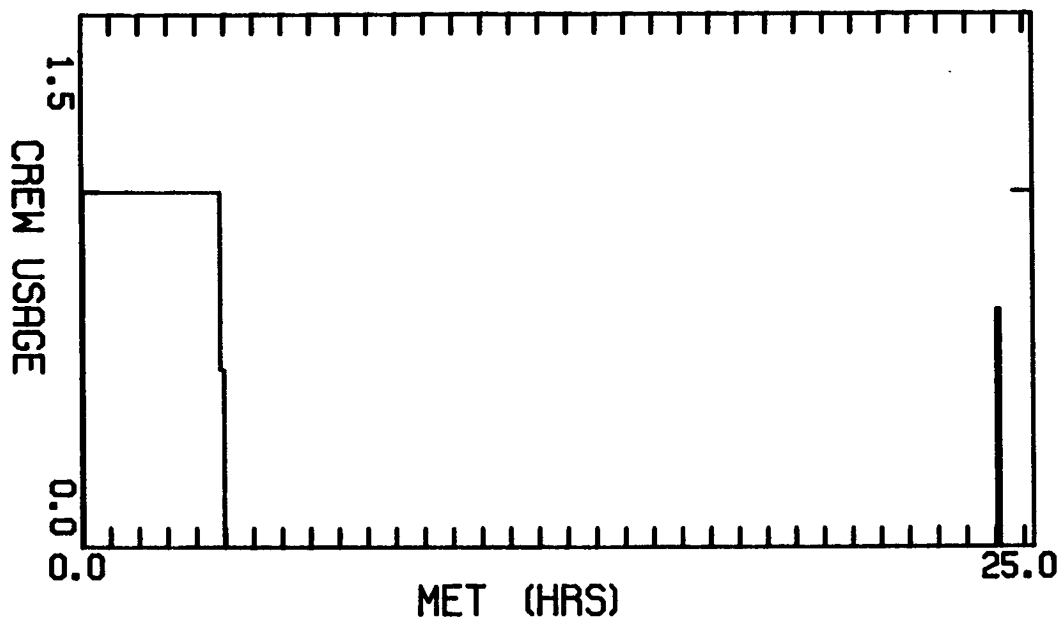


HAL THERMAL

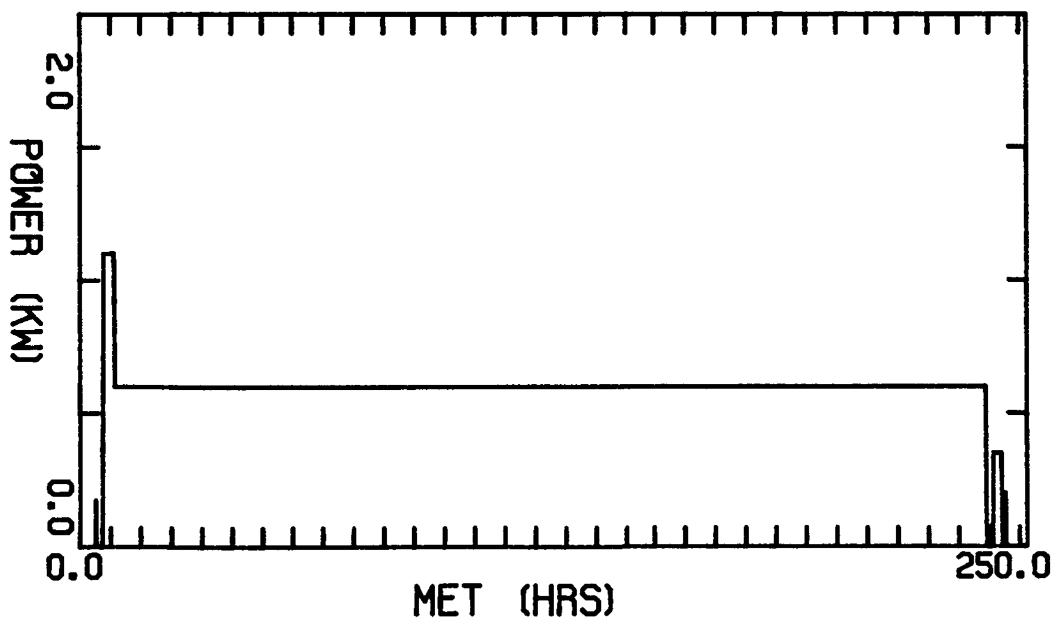


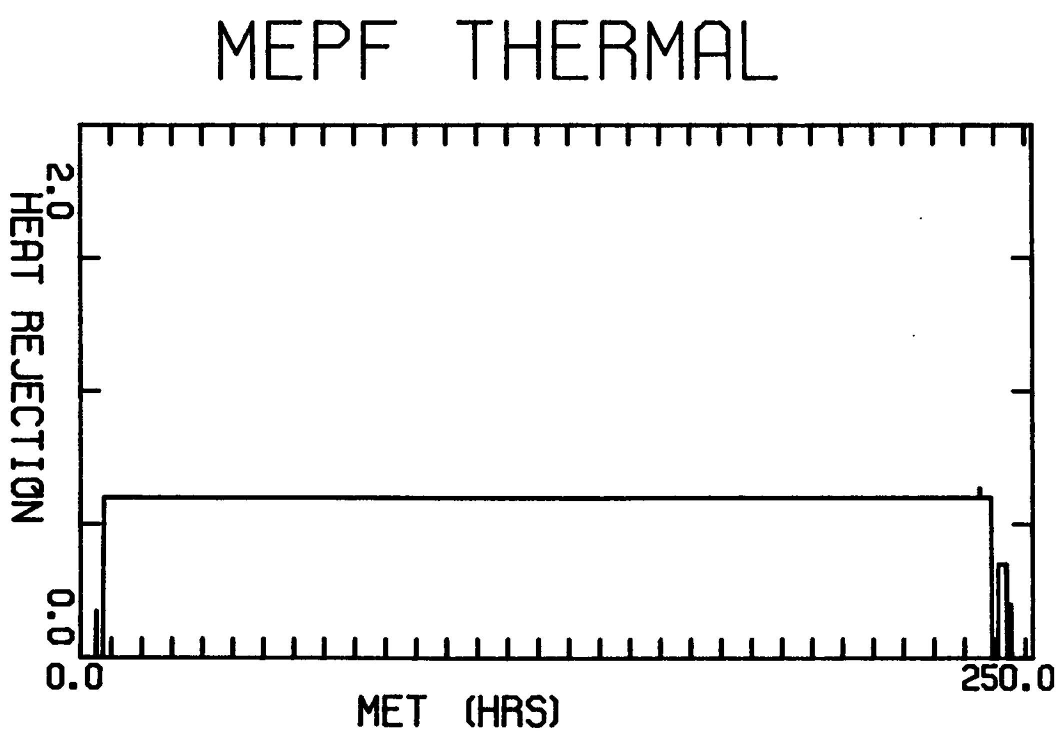

HAL DATA
DATA (KBPS)
4.0
0.0
0.0
25.0
MET (HRS)

HAL

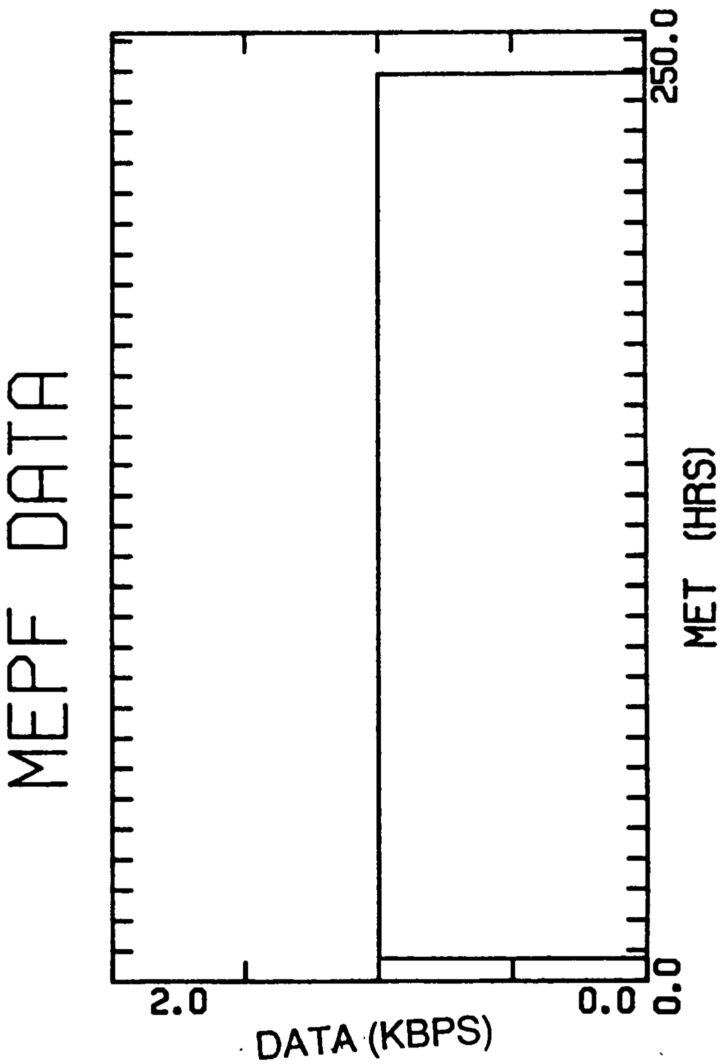


MEPF PØWER

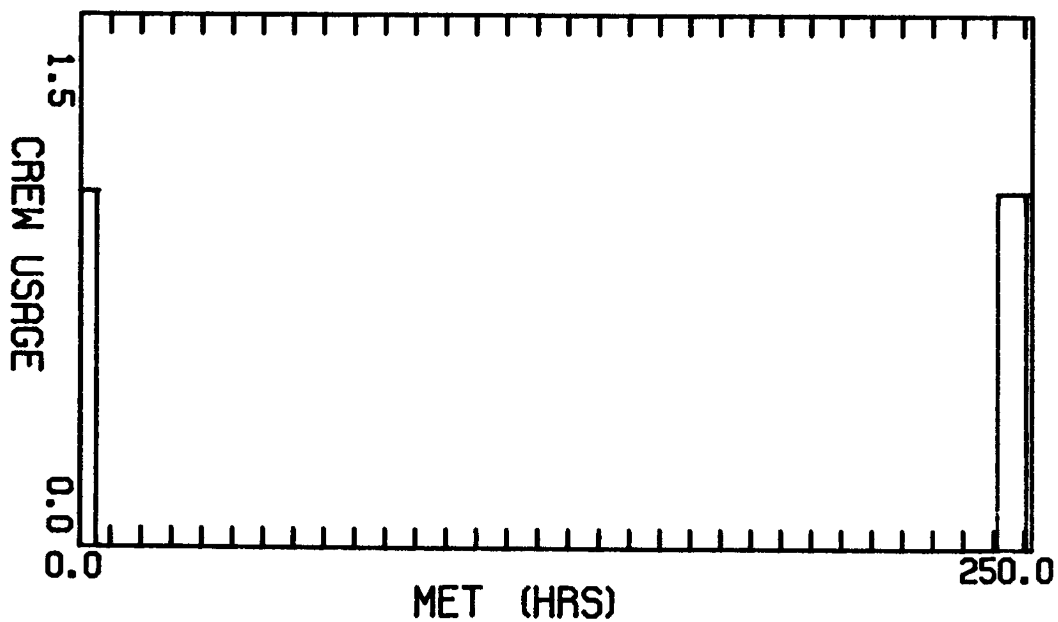




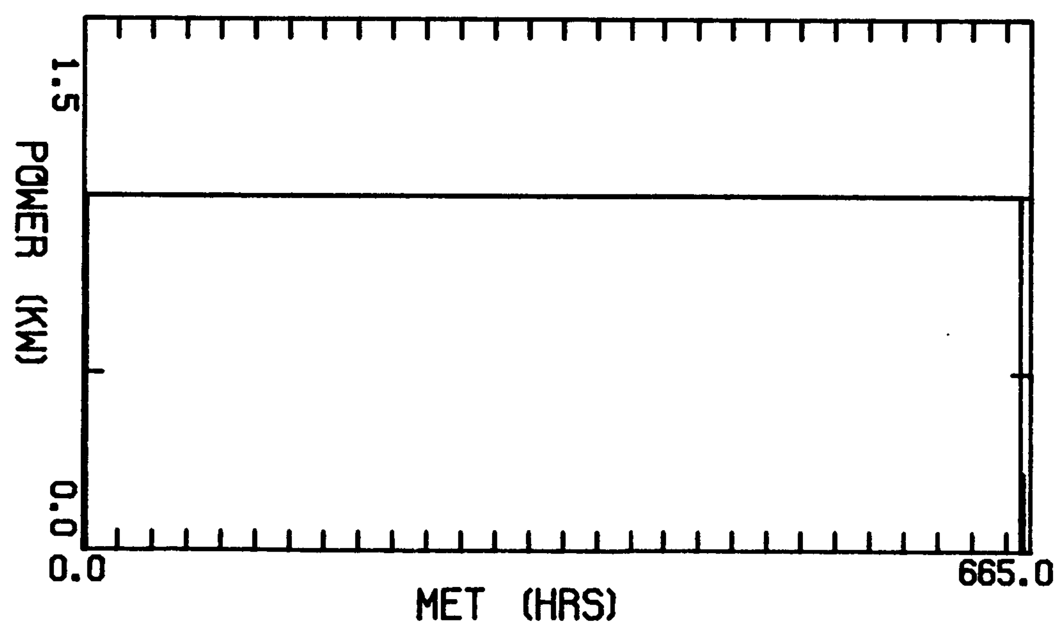
MEPF THERMAL
2.0
HEAT REJECTION
0.0
0.0
250.0
MET (HRS)

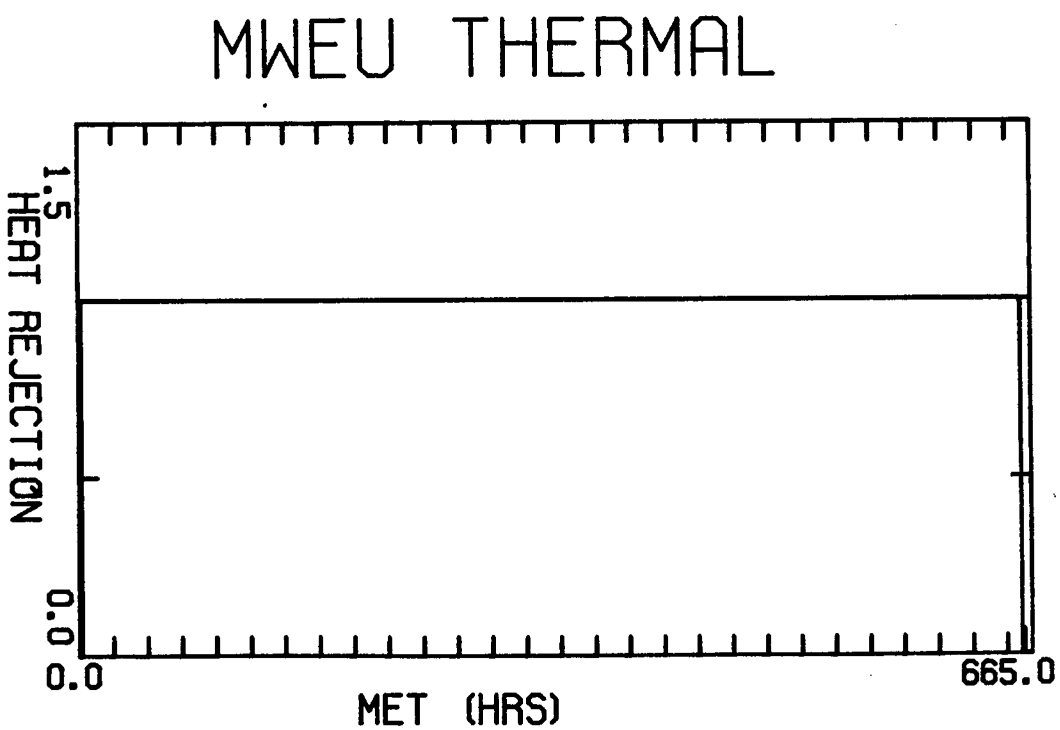

MEPF DATA
250.0
0.0
MET (HRS)
2.0
0.0
DATA (KBPS)

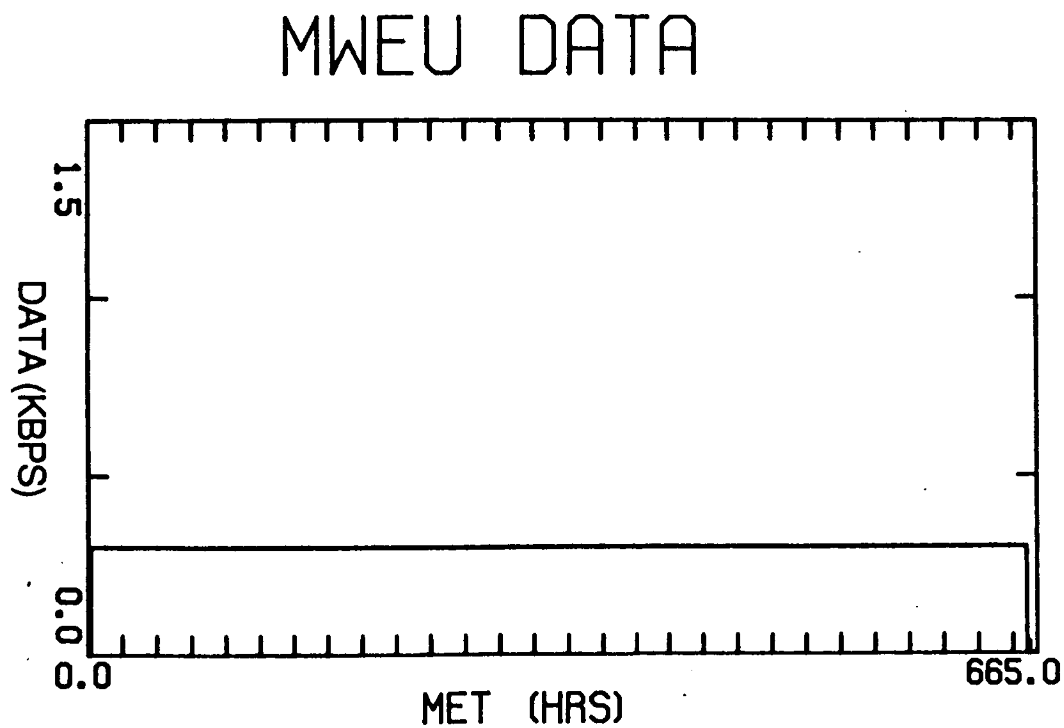
MEPF



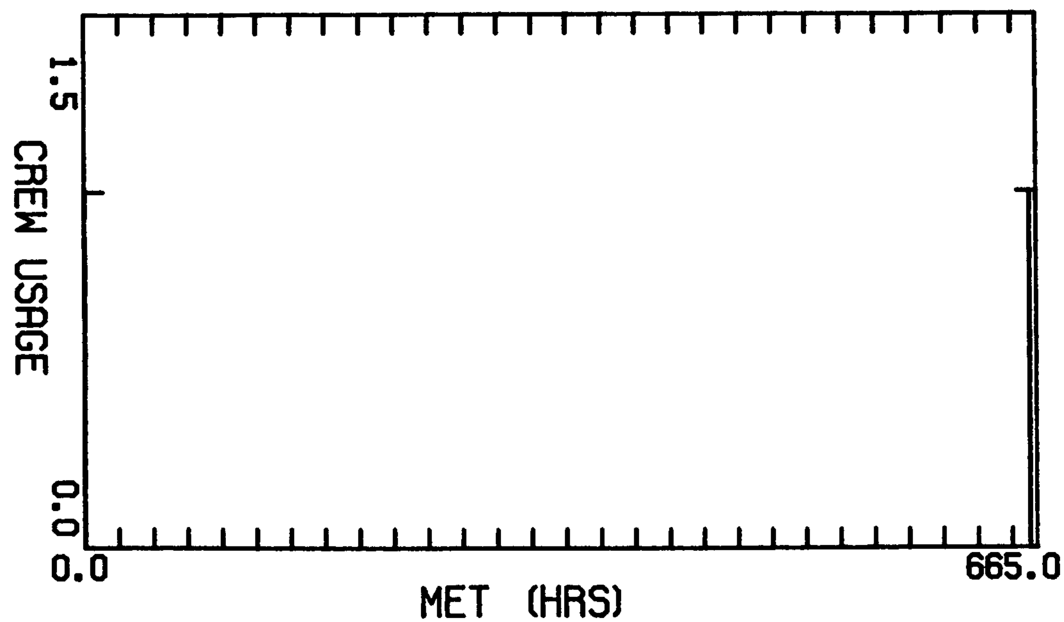
MWEU PØWER



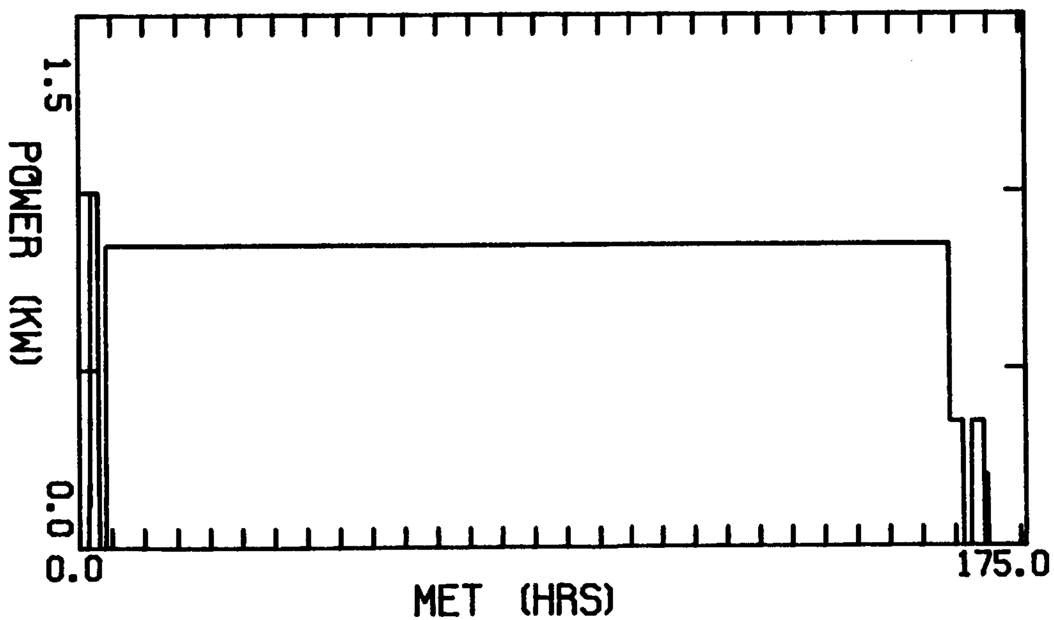

MWEU THERMAL
1.5
HEAT REJECTION
0.0
0.0
665.0
MET (HRS)


MWEU DATA
1.5
0.0
DATA (KBPS)
0.0
665.0
MET (HRS)

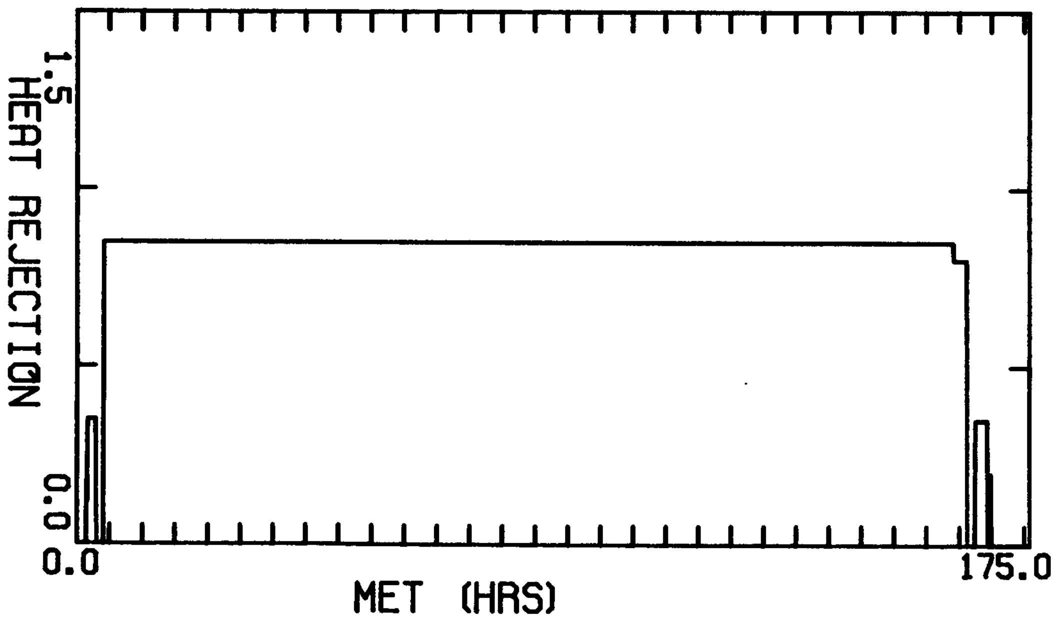
MWEU



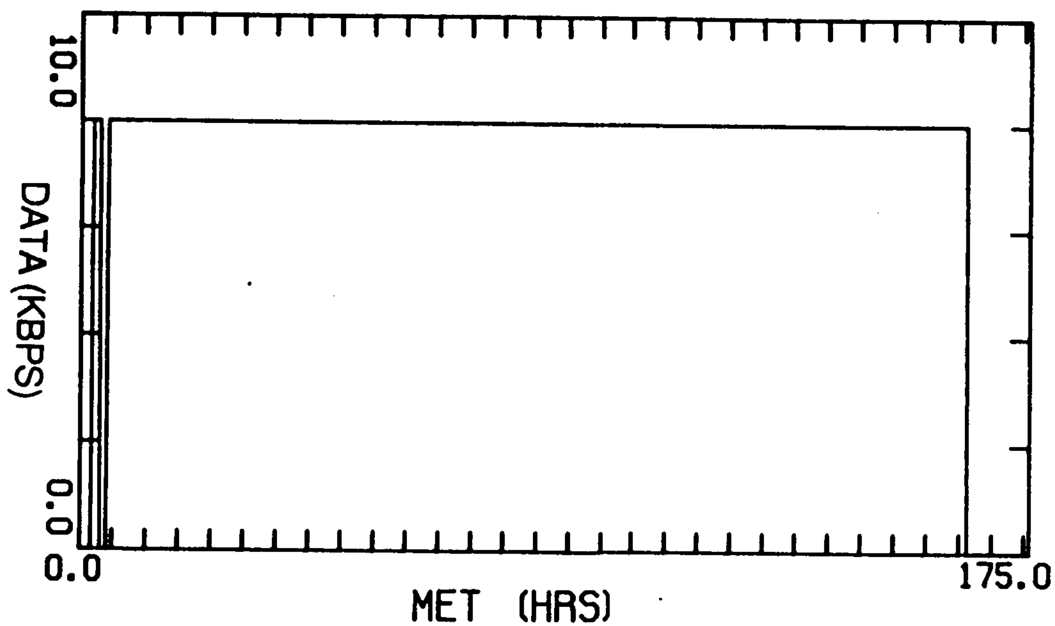
NFF-1 POWER



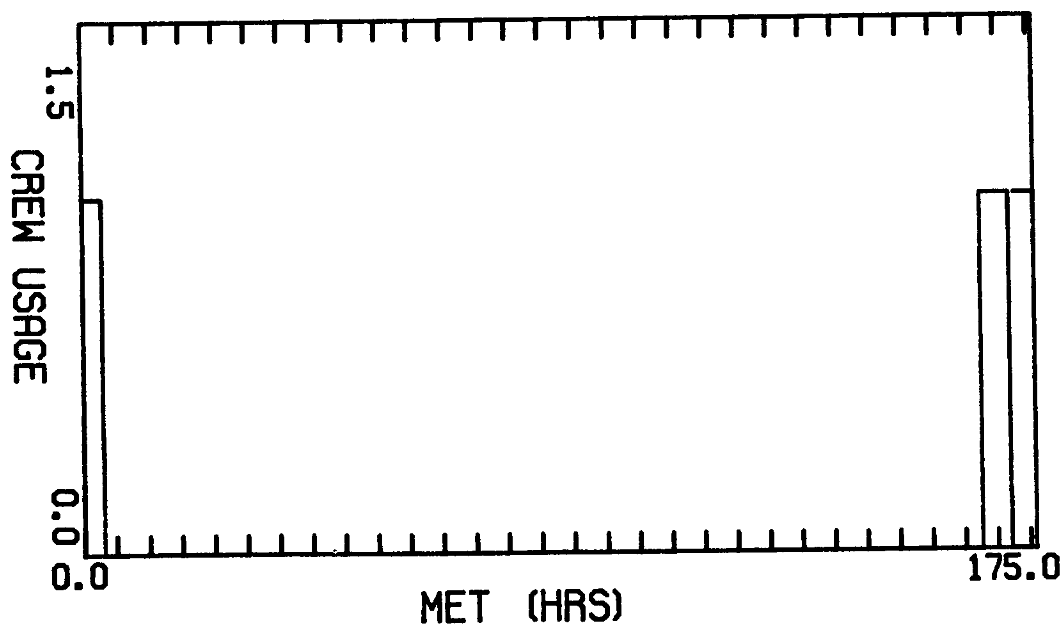
NFF-1 THERMAL



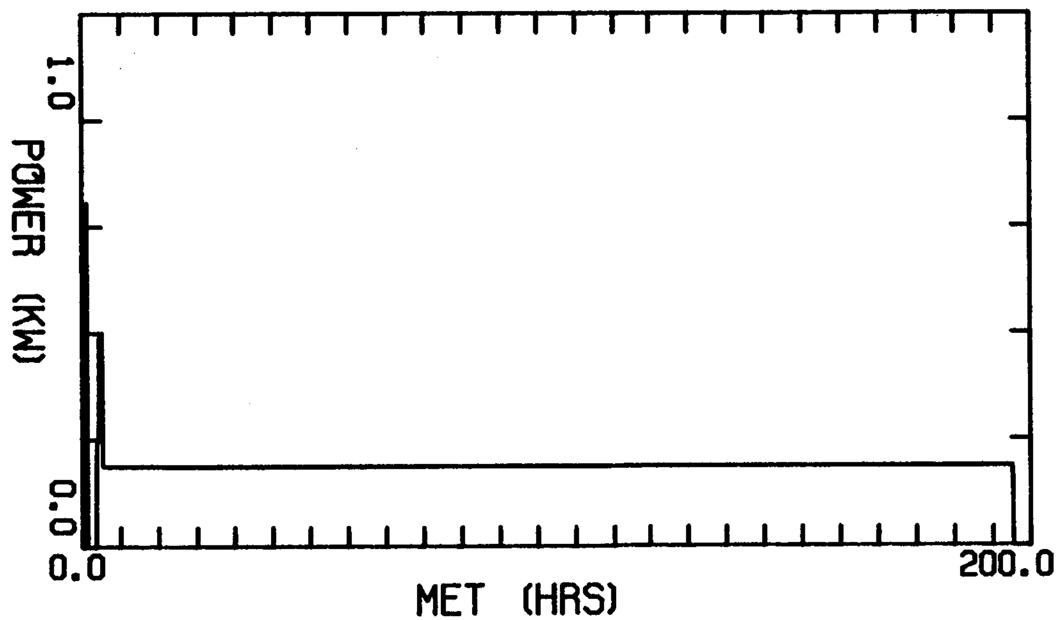
NFF-1 DATA

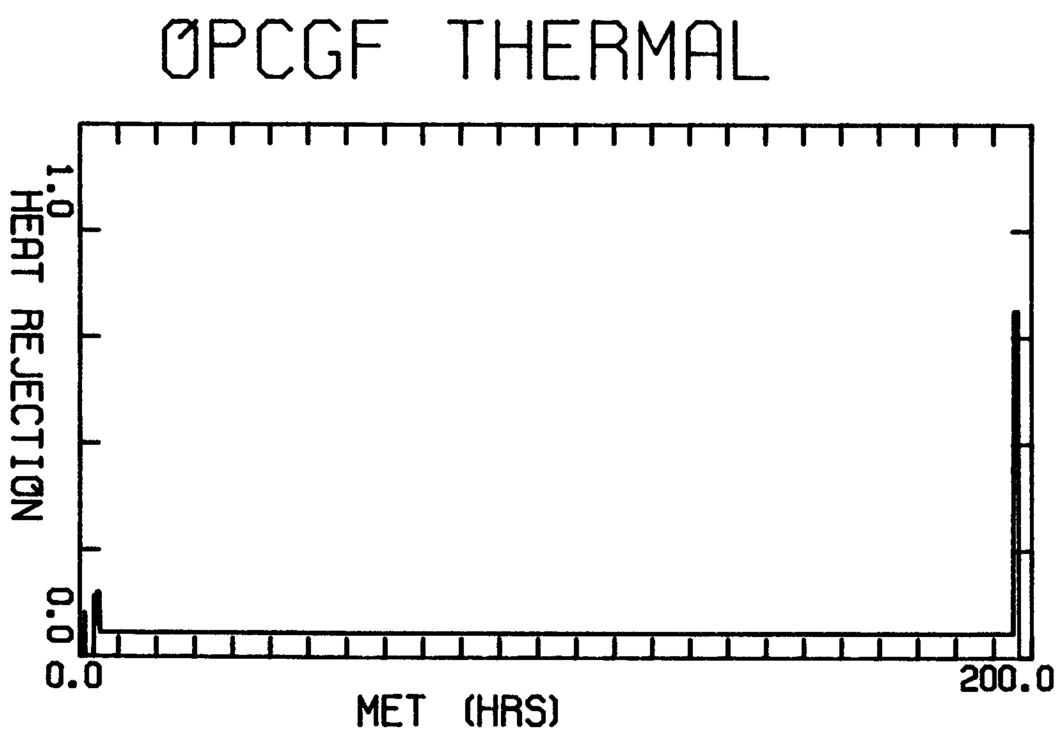


NFF-1

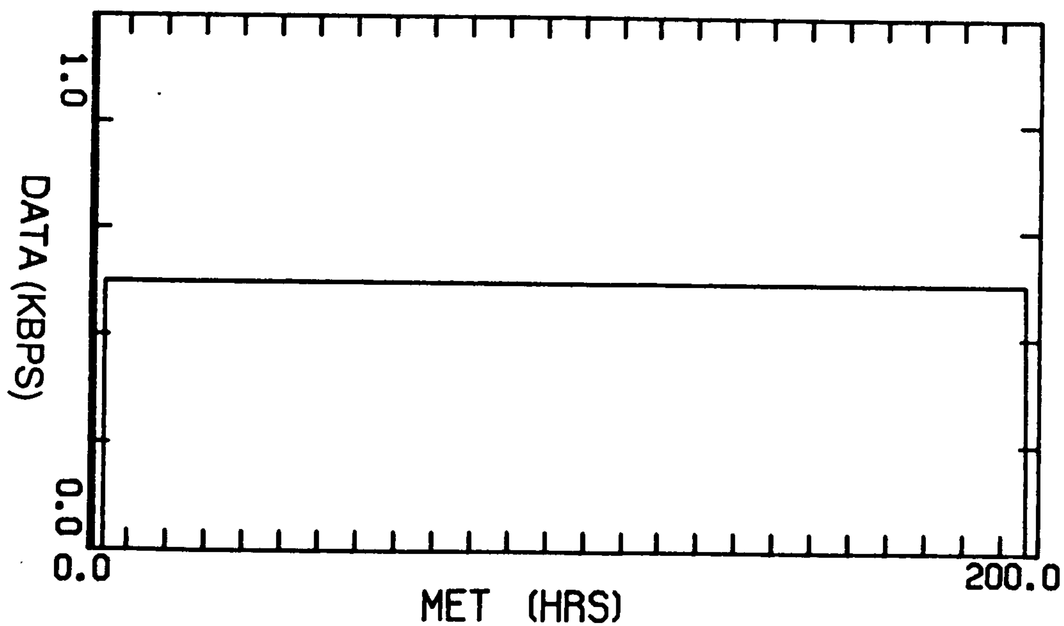


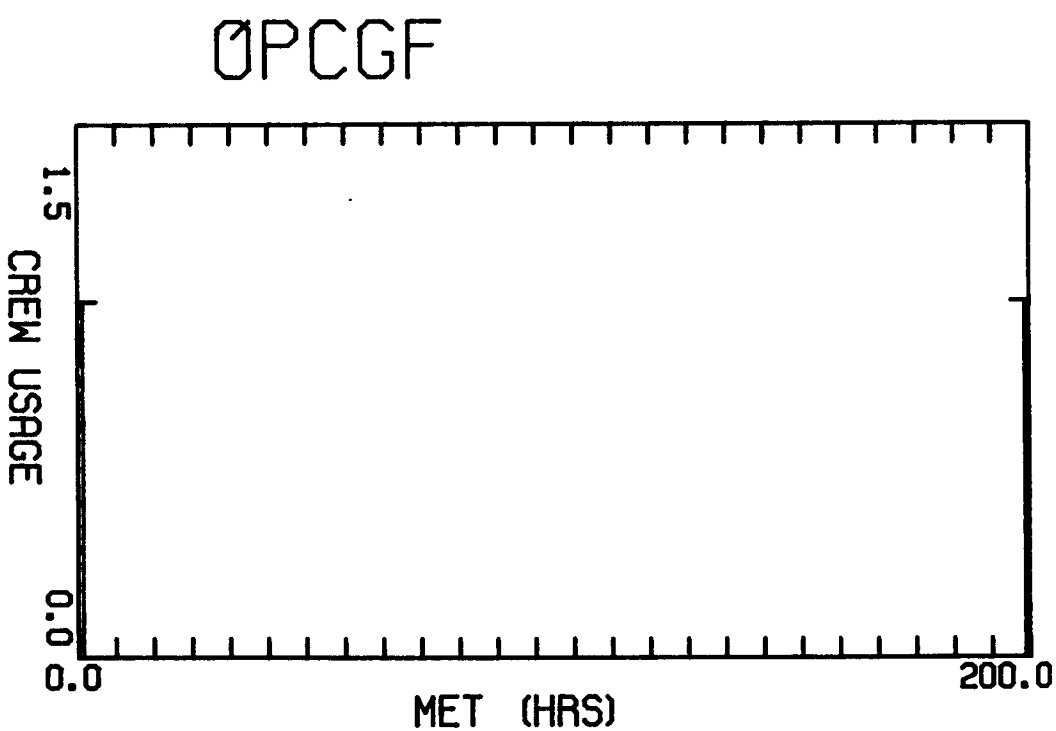
ØPCGF PØWER



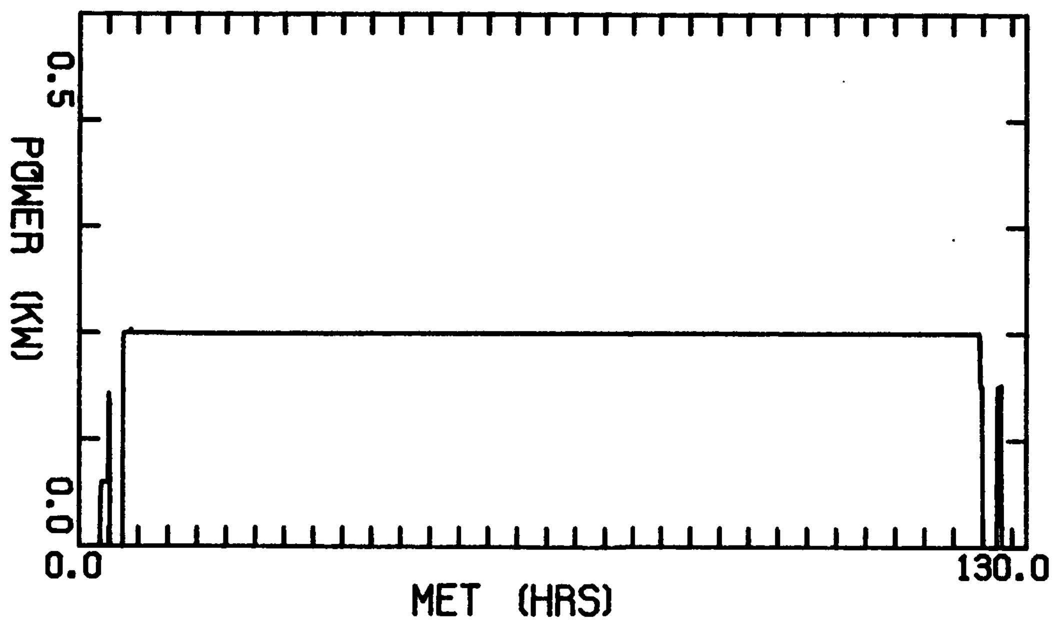

ØPCGF THERMAL
1.0
0.0
HEAT REJECTIØN
0.0
200.0
MET (HRS)

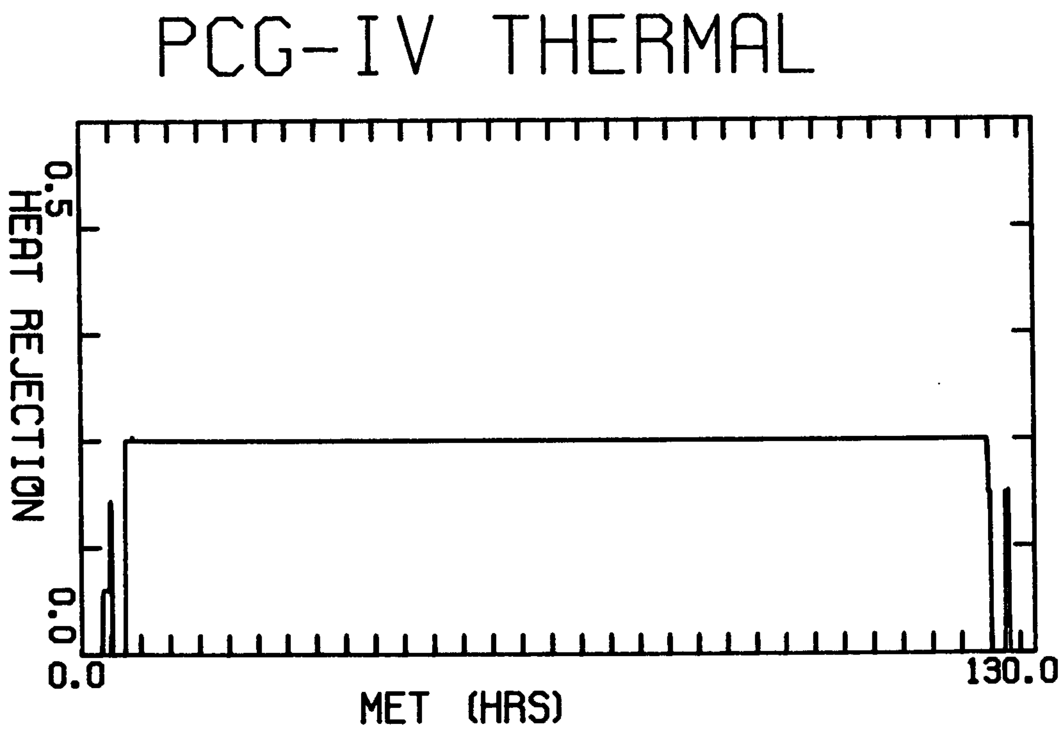
ØPCGF DATA



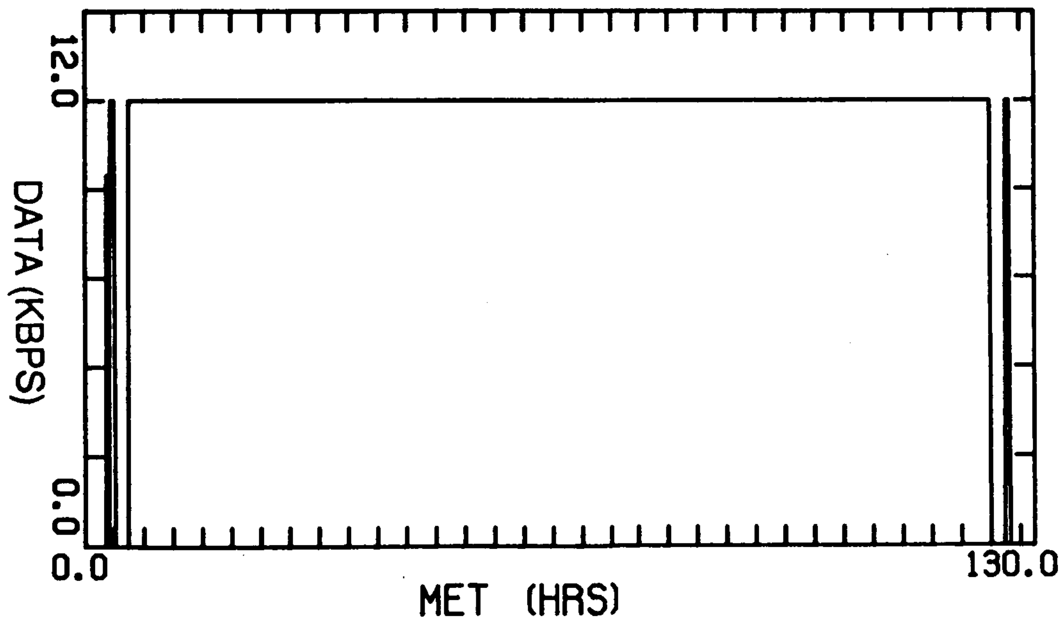

ØPCGF
1.5
CREW USAGE
0.0
0.0
MET (HRS)
200.0

PCG-IV PØWER

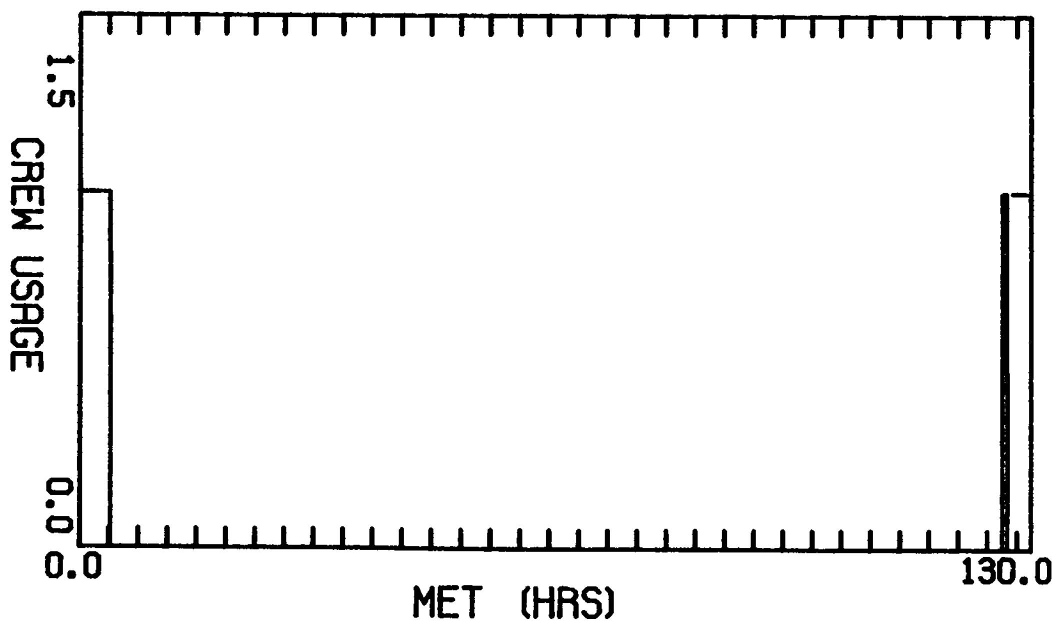


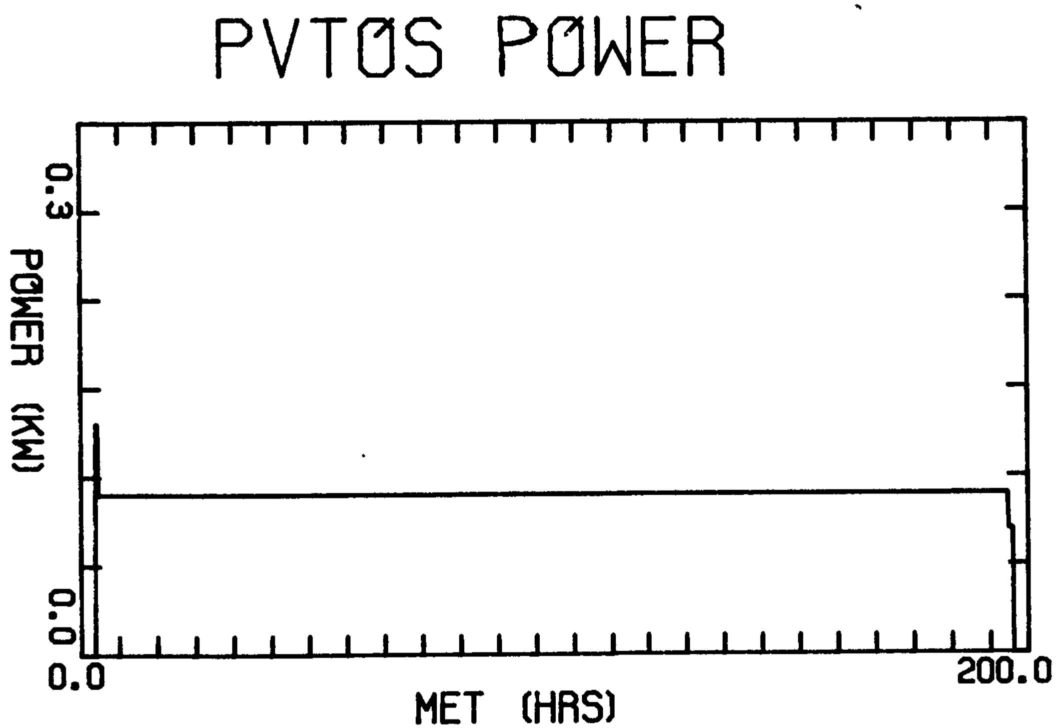

PCG-IV THERMAL
HEAT REJECTION
0.5
0.0
0.0
130.0
MET (HRS)

PCG-IV DATA

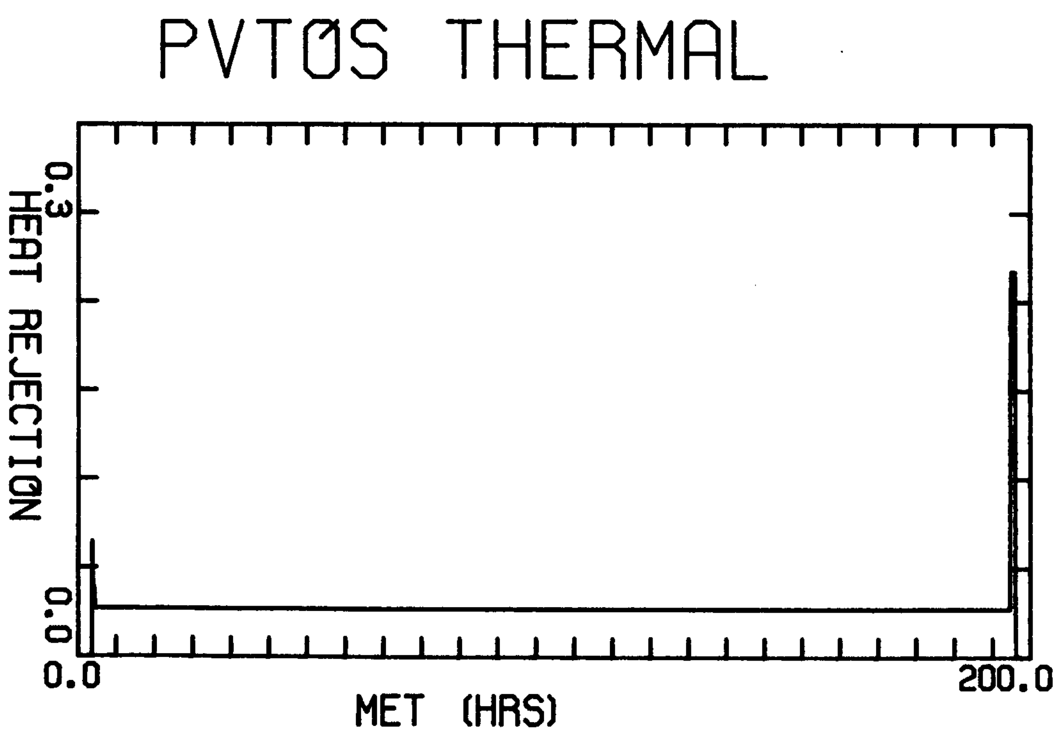


PCG-IV

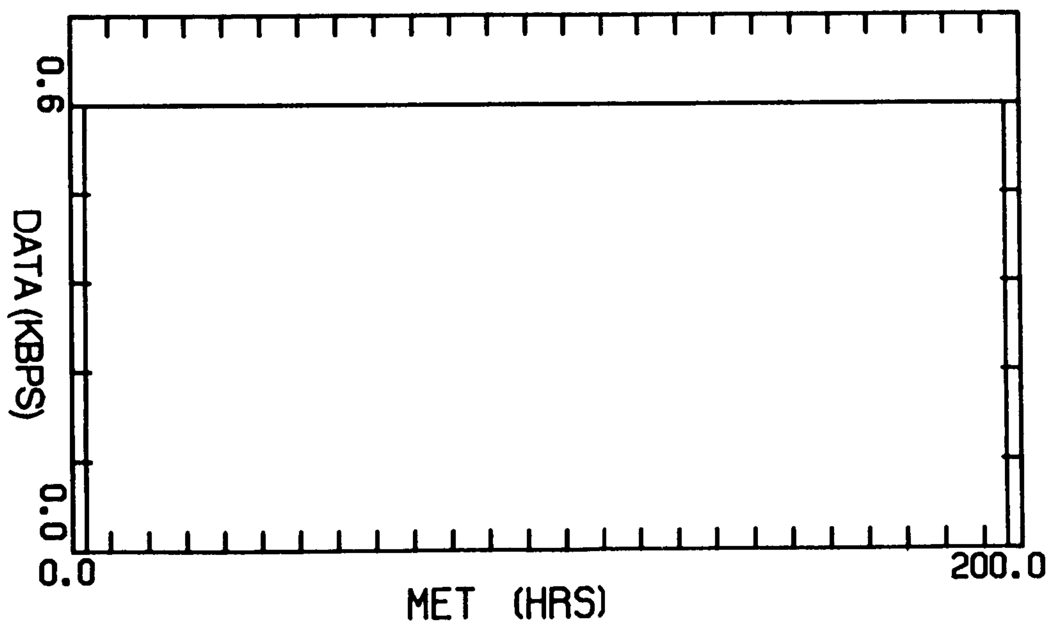




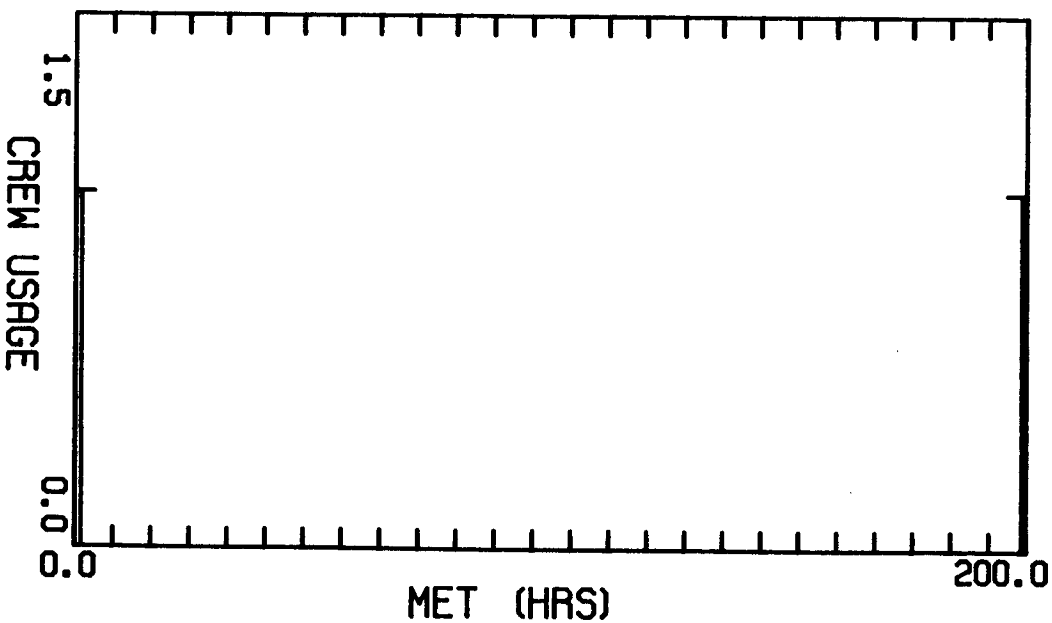
PVTØS POWER
0.3
0.0
POWER (KW)
0.0
200.0
MET (HRS)

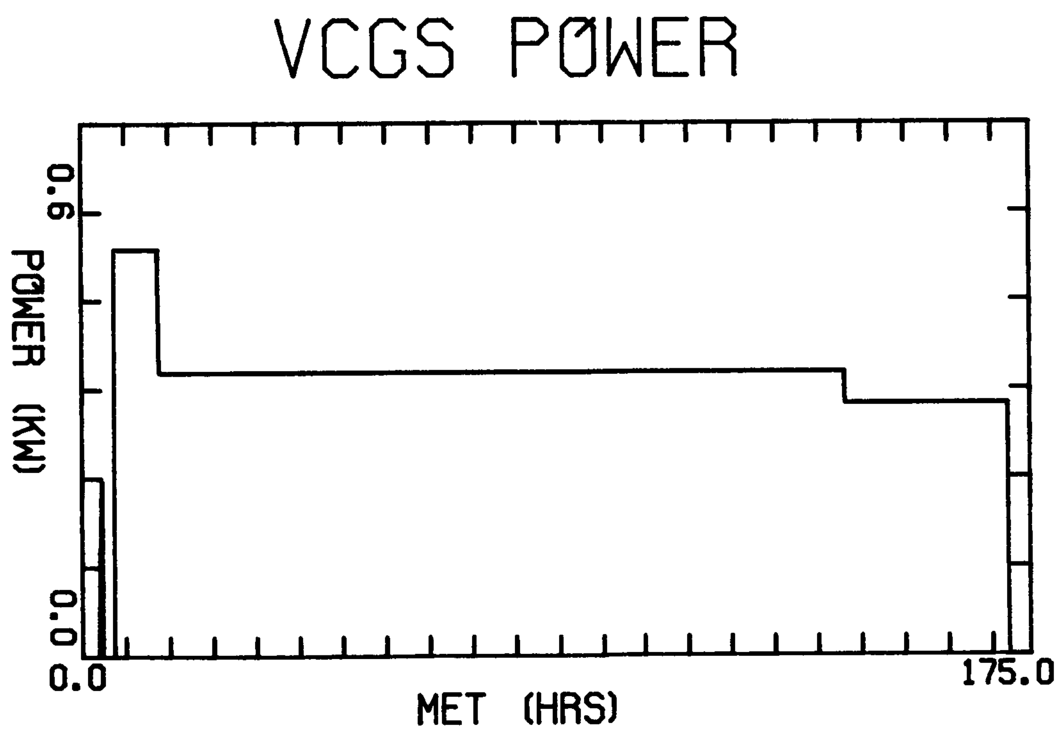

PVTØS THERMAL
HEAT REJECTION
0.3
0.0
0.0
200.0
MET (HRS)

PVTØS DATA

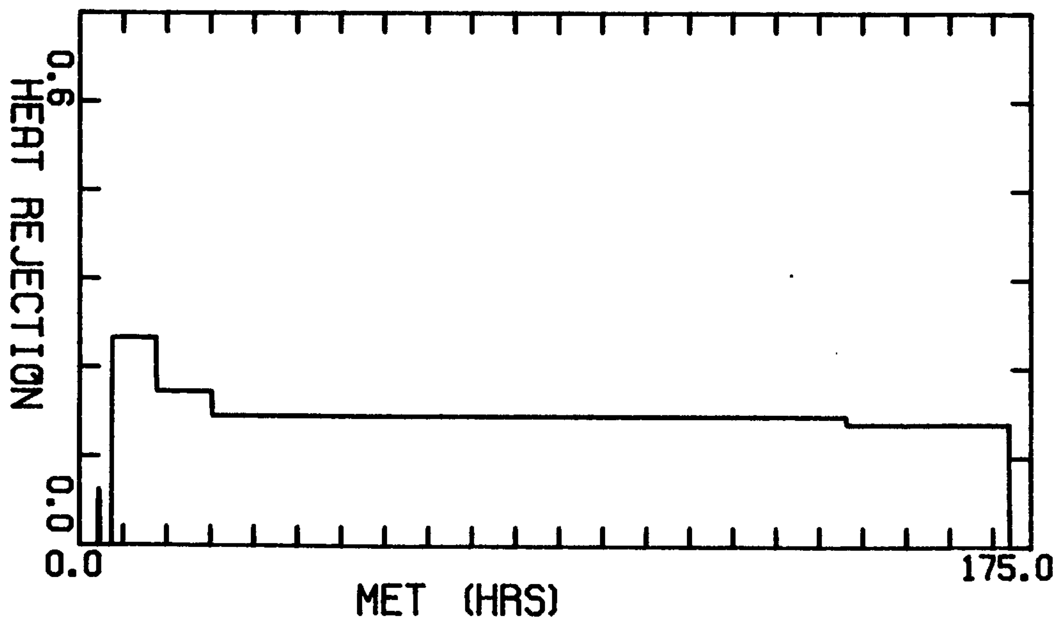


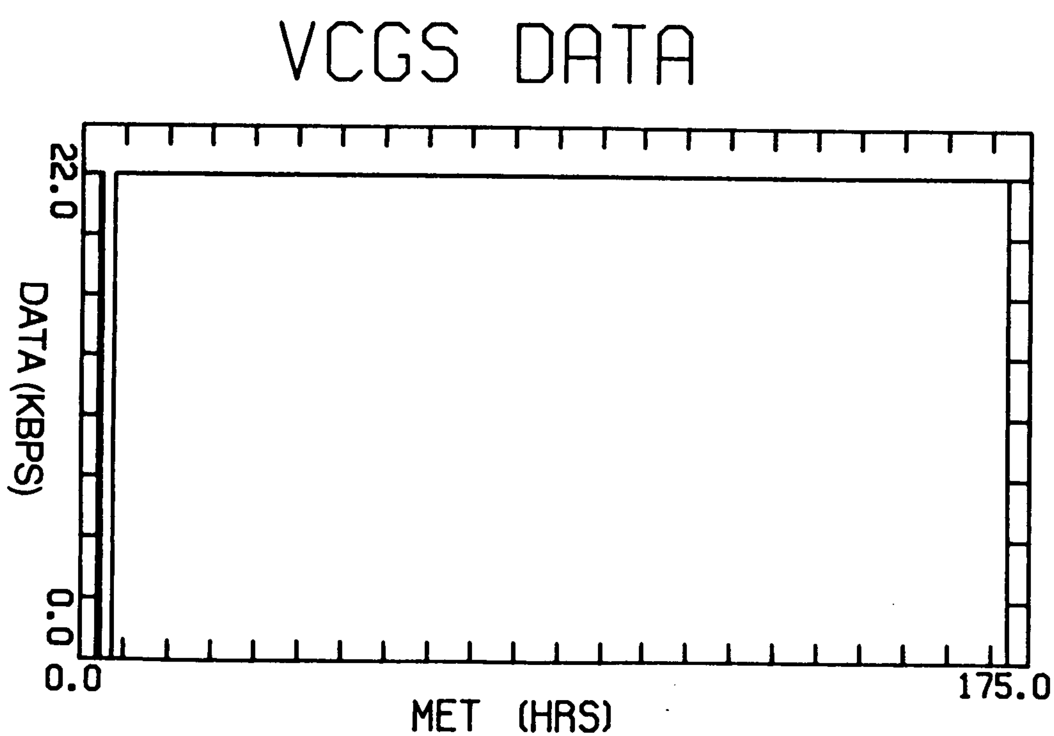
PVTØS

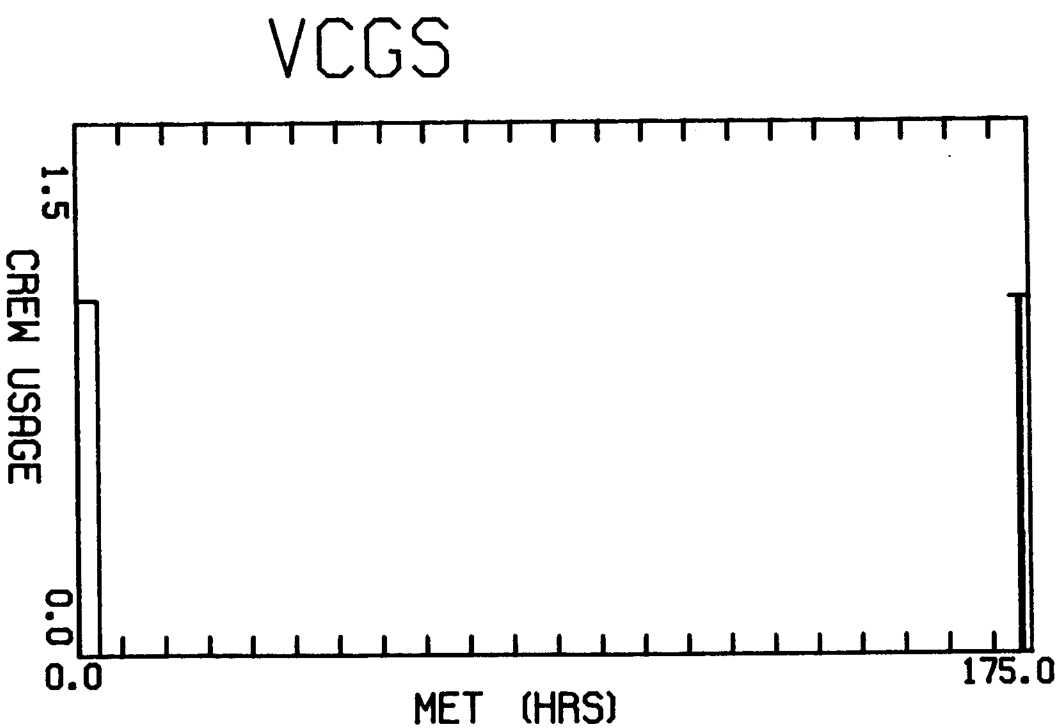



VCGS PØWER
0.6
0.0
PØWER (KW)
0.0
175.0
MET (HRS)

VCGS THERMAL




VCGS DATA
22.0
0.0
DATA (KBPS)
0.0
175.0
MET (HRS)

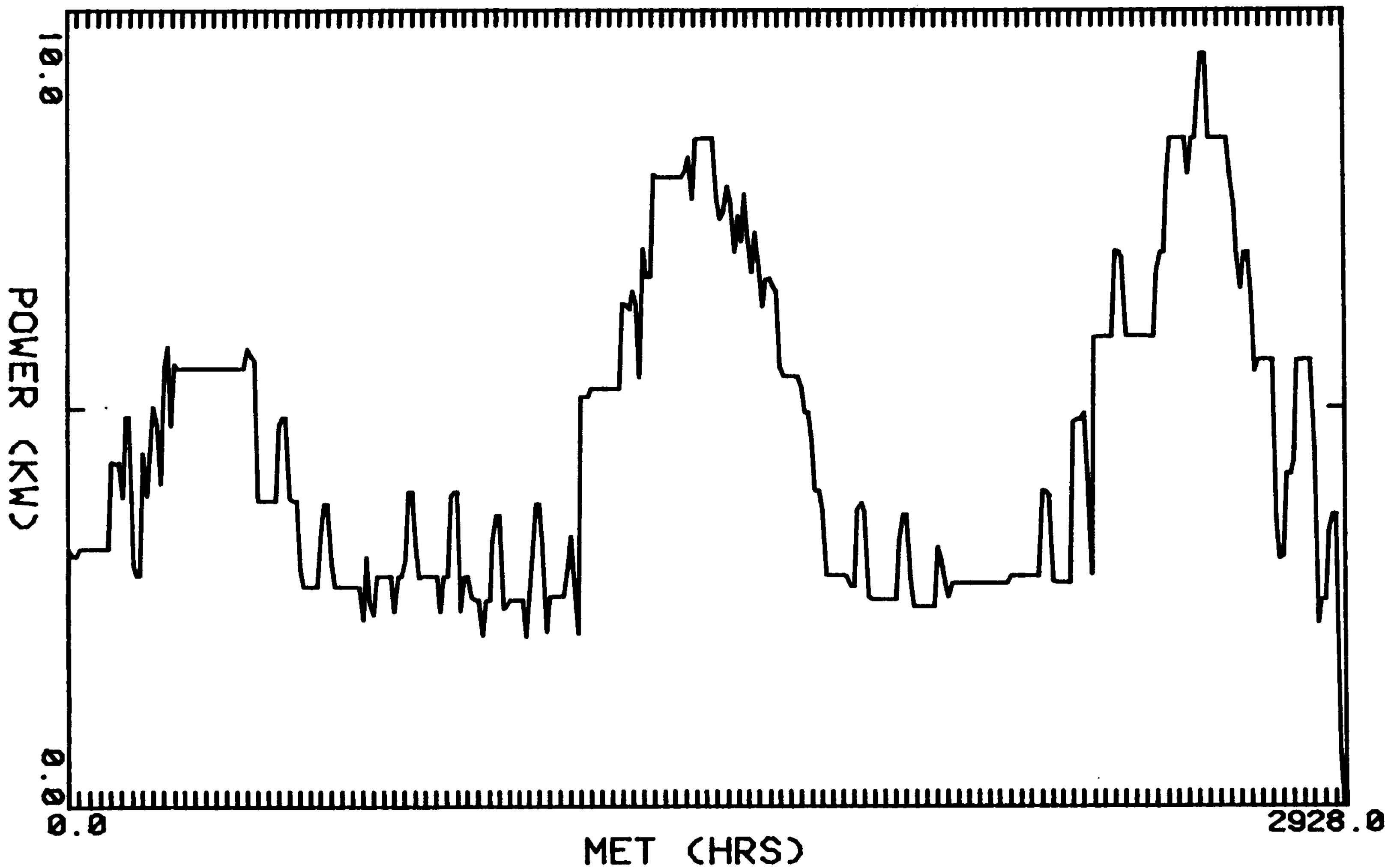

VCGS
1.5
CREW USAGE
0.0
0.0
MET (HRS)
175.0

EXPERIMENTS /FACILITIES	FACILITY RUN PARAMETERS			
	SET-UP TIME (MIN)	RUN TIME (MIN)	SERVICE TIME (MIN)	CREW TIME (MIN)
3AAL	190	270	2	192
AADSF	151	15000	351	498
CVT	207	3515	20	227
DMOS	72	10200	60	132
ECG	244	10804	48	288
EML	199	3200	2	198
FES	605	3281	12	367
FZCGF	160	831	15	121
HAL	219	1045	4	223
MEPF	258	13994	446	584
MWEU	29	39360	23	52
NFF-1	218	9510	331	457
OPCGF	70	11655	30	100
PCG-IV	251	7081	39	281
PVTOS	80	11635	30	110
VCGS	228	9905	32	260

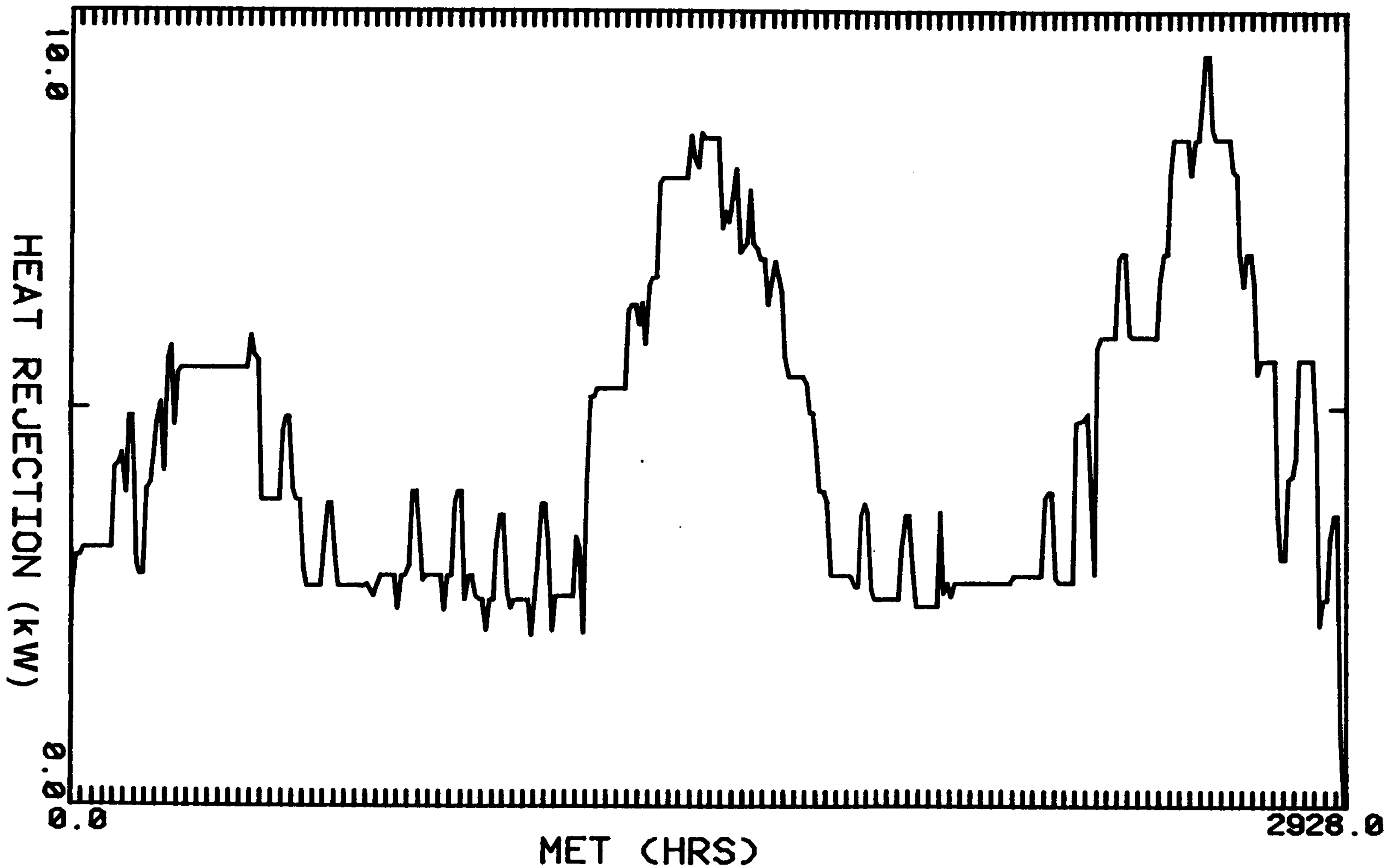
RUNS TABLE			
EXPERIMENT	MINIMUM No. RUNS	MAXIMUM No RUNS WITH OUT MODIFICATION	MAXIMUM No RUNS WITH MODIFICATION
3AAL	1	2	16
AADSF	1	1	50
CVT	1	2	50
DMOS	1	1	20
ECG	1	6	6
EML	1	6	6
FES	1	1	50
FZCGF	1	1	15
HAL	1	16	50
MEPF	1	20	60
MWEU	1	1	2
NFF-1	1	1	45
OPCGF	1	1	20
PCG-IV	1	50	50
PVTOS	1	1	20
VCGS	1	1	50

POWER TABLE			
SCENARIO NUMBER	DURATION (DAYS)	BETA ANGLE	CAPACITY
1	120	LOW	7 RACKS & 32 MIDDECK LOCKERS
2	180	HIGH	7 RACKS & 32 MIDDECK LOCKERS
3	120	LOW	15 RACKS & 64 MIDDECK LOCKERS
4	180	HIGH	15 RACKS & 64 MIDDECK LOCKERS
5	120	HIGH	7 RACKS & 32 MIDDECK LOCKERS
6	180	LOW	7 RACKS & 32 MIDDECK LOCKERS
7	120	HIGH	15 RACKS & 64 MIDDECK LOCKERS
8	180	LOW	15 RACKS & 64 MIDDECK LOCKERS
9	180	N/A	7 RACKS & 32 MIDDECK LOCKERS
10	120	N/A	7 RACKS & 32 MIDDECK LOCKERS

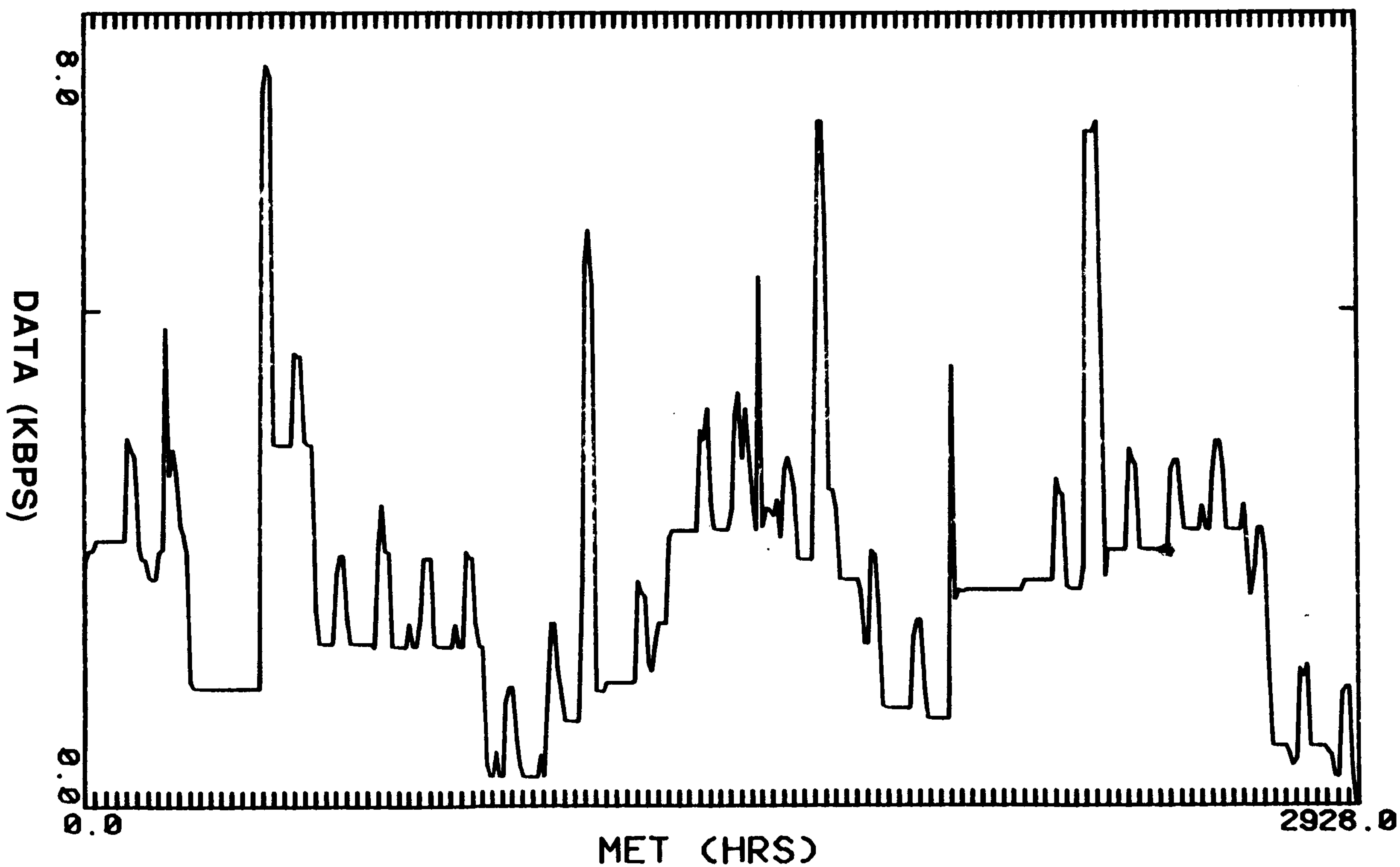
SCENARIO SF1

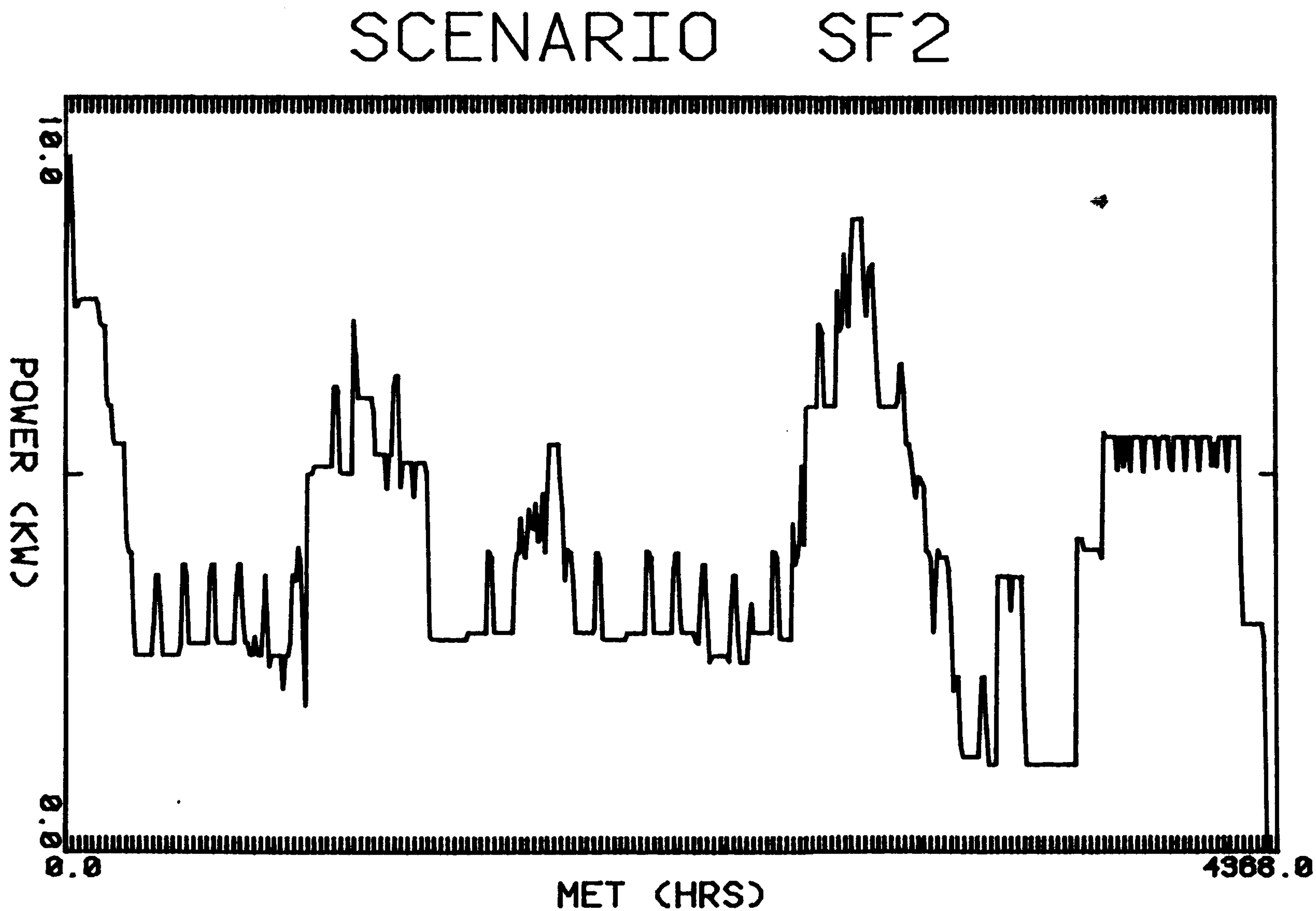


SCENARIO SF1

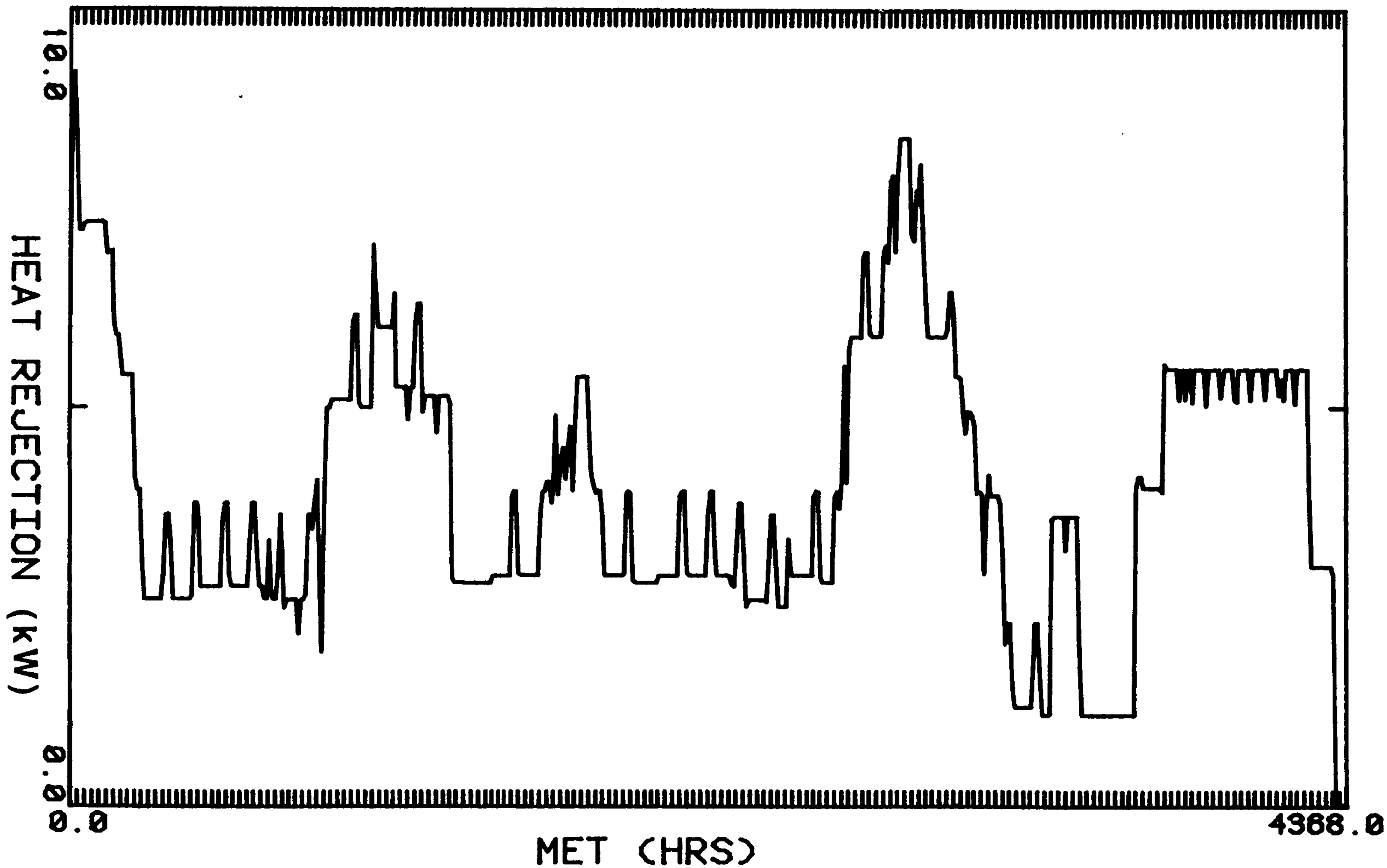


SCENARIO SF1 DAT

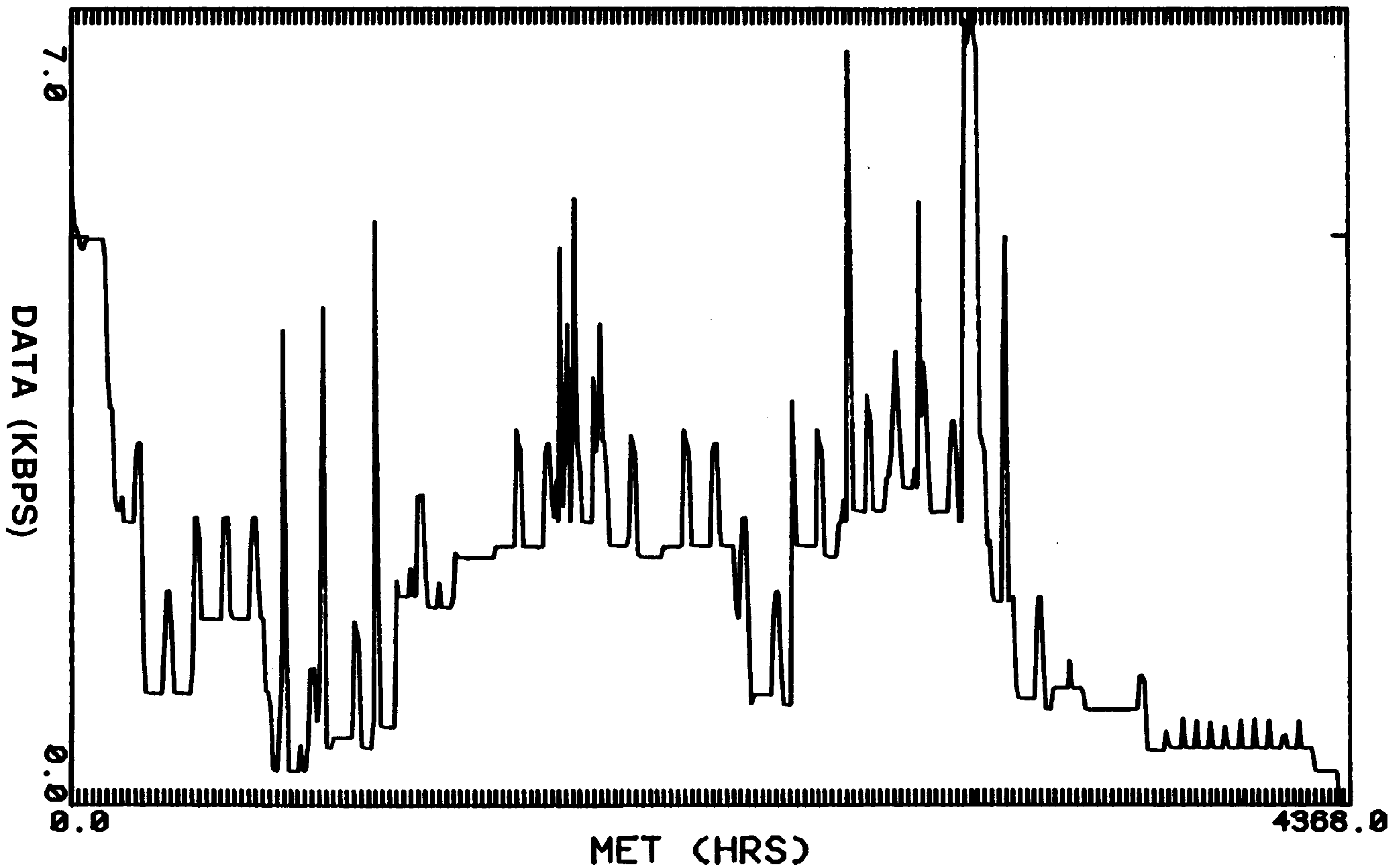



SCENARIO SF2
10.0
0.0
POWER (KW)
0.0
4368.0
MET (HRS)

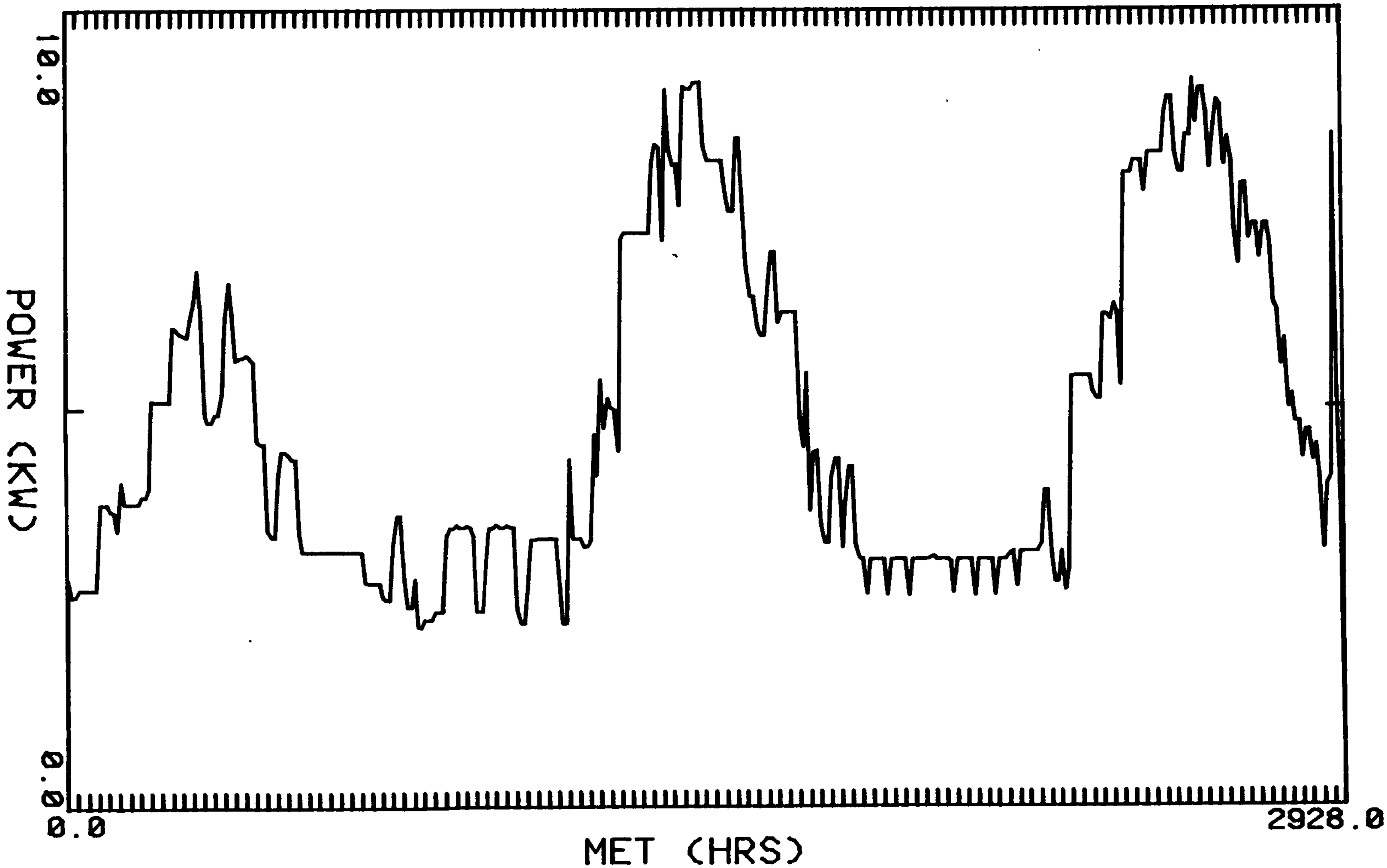
SCENARIO SF2

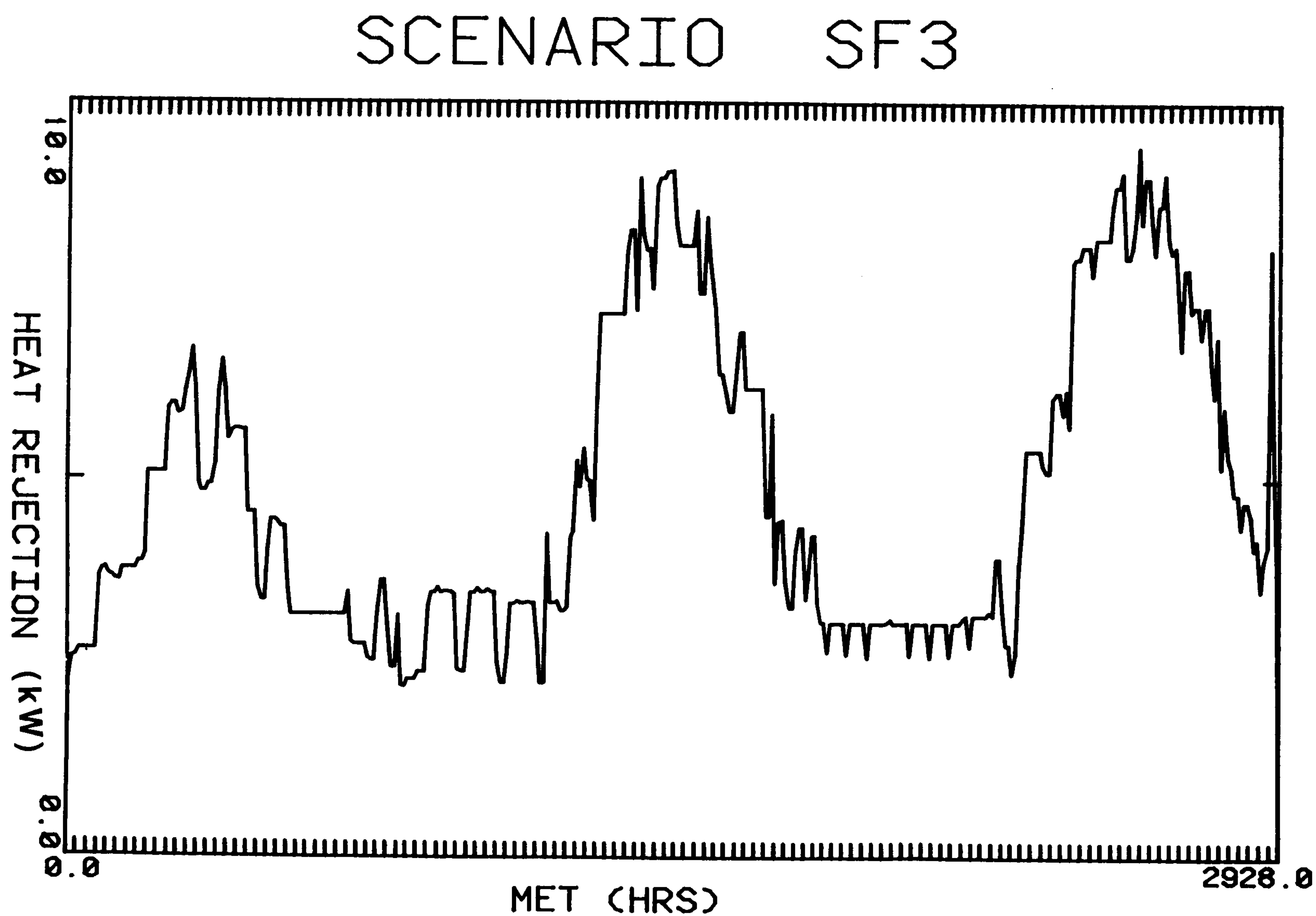


SCENARIO SF2 DAT

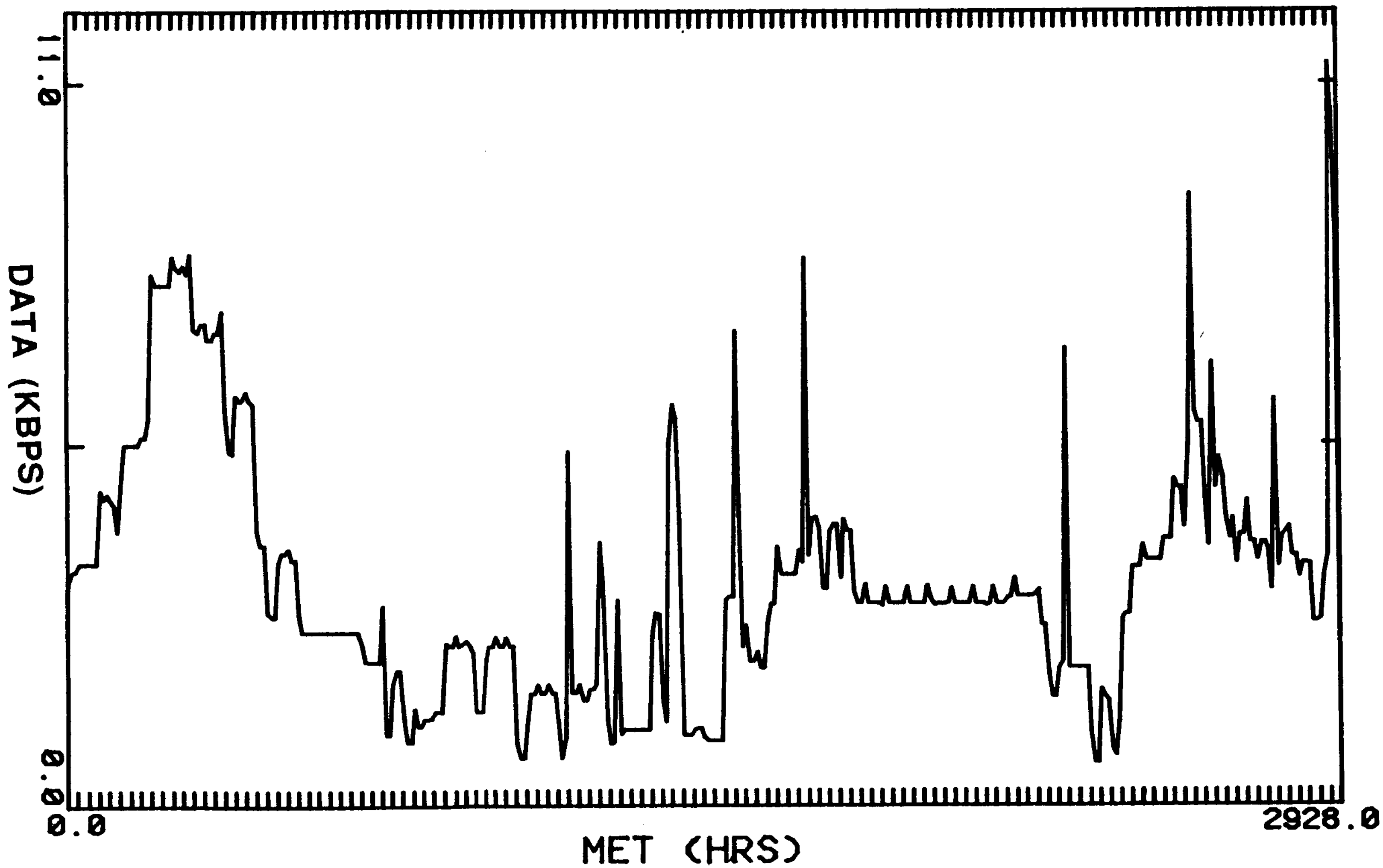


SCENARIO SF3

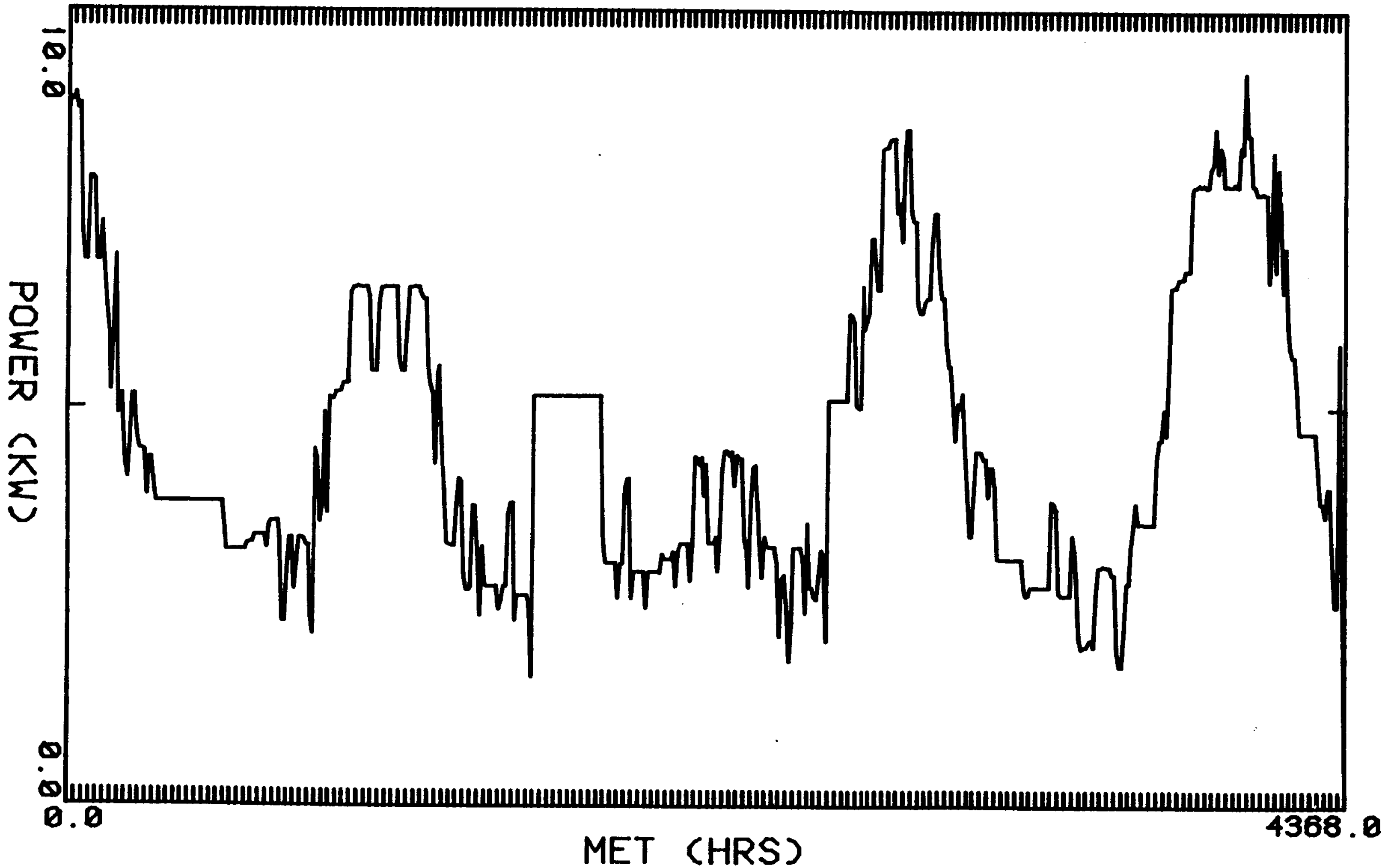



SCENARIO SF3
10.0
0.0
HEAT REJECTION (kW)
0.0
2928.0
MET (HRS)

SCENARIO SF3 DAT



SCENARIO SF4



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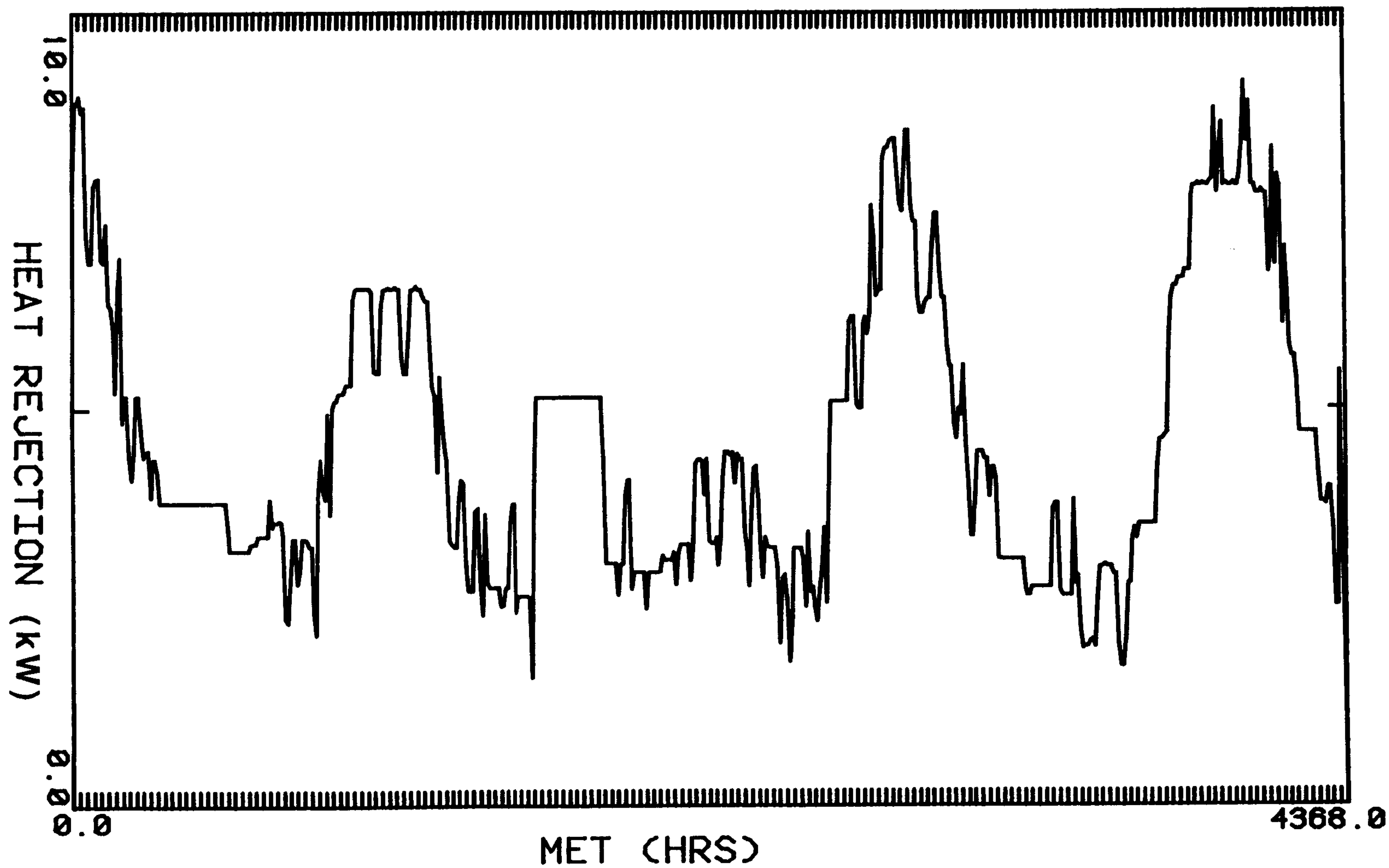

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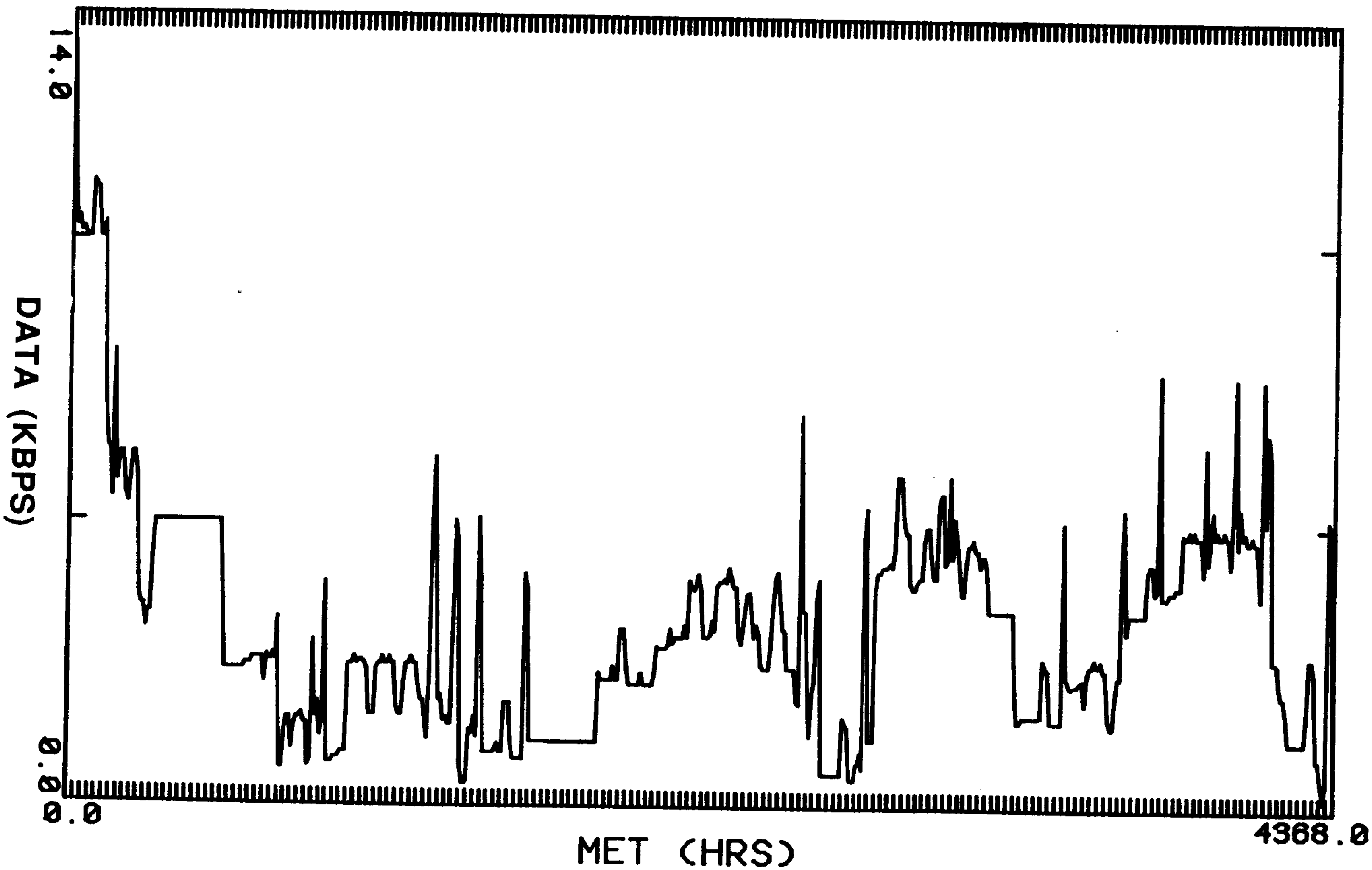
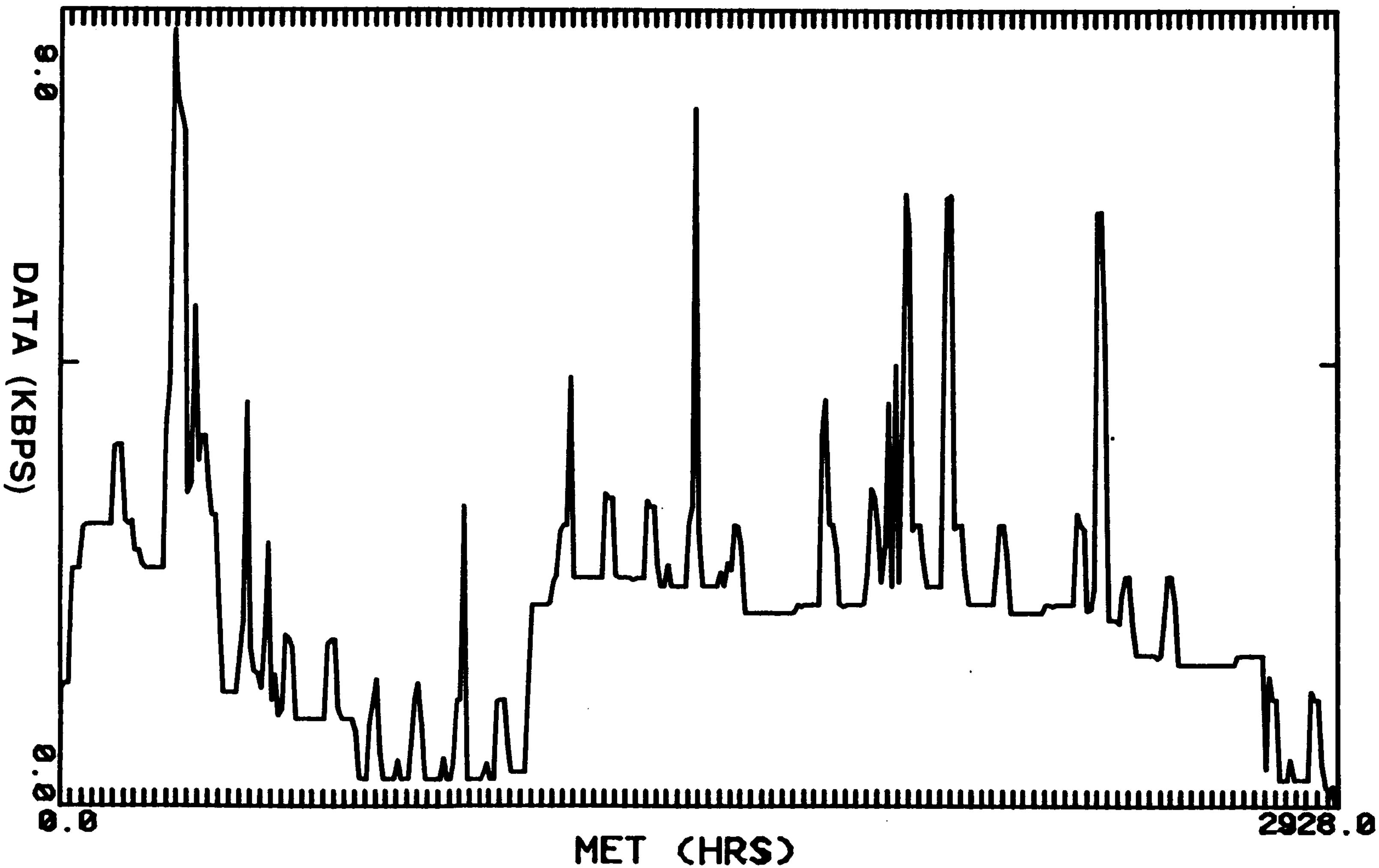
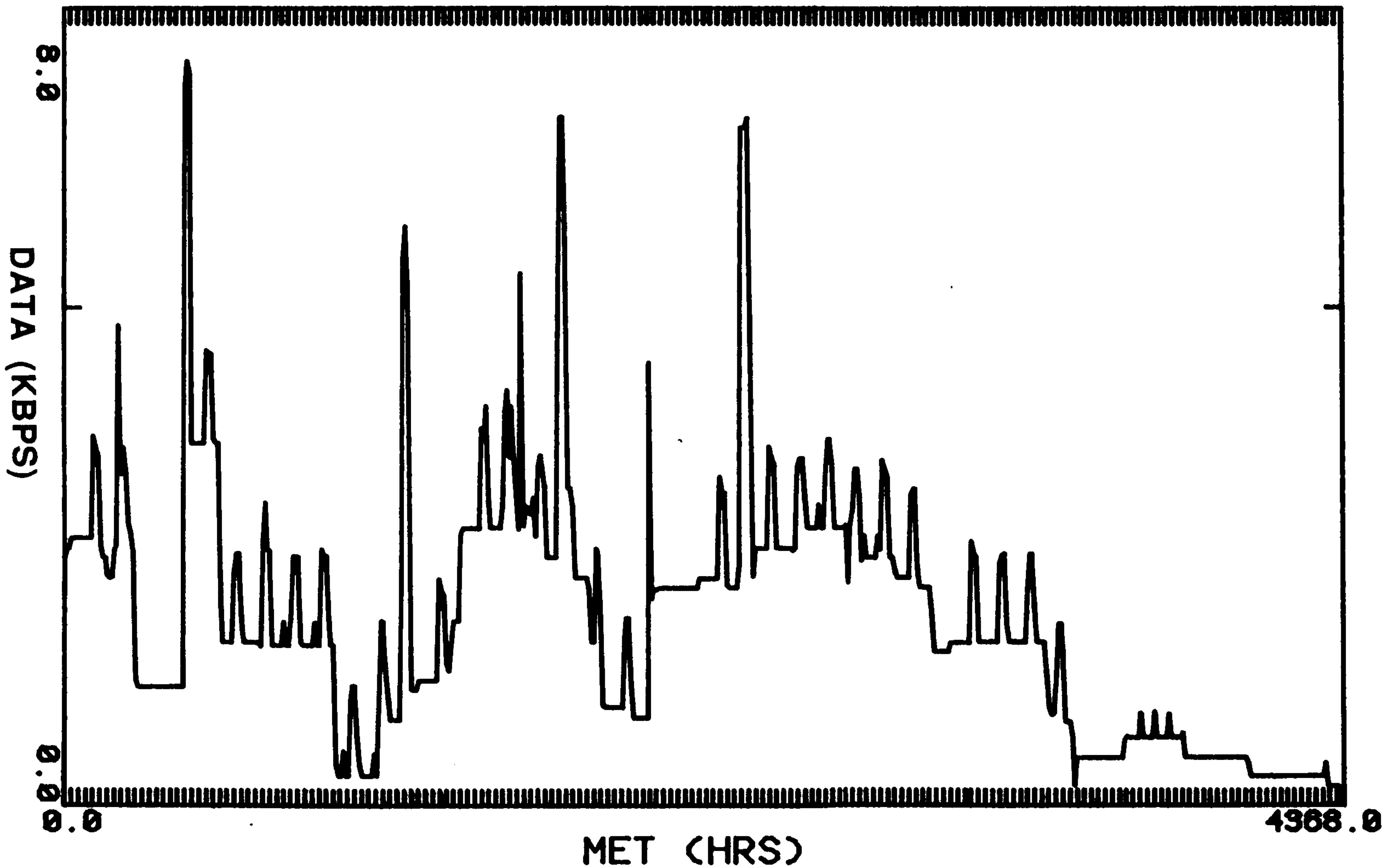
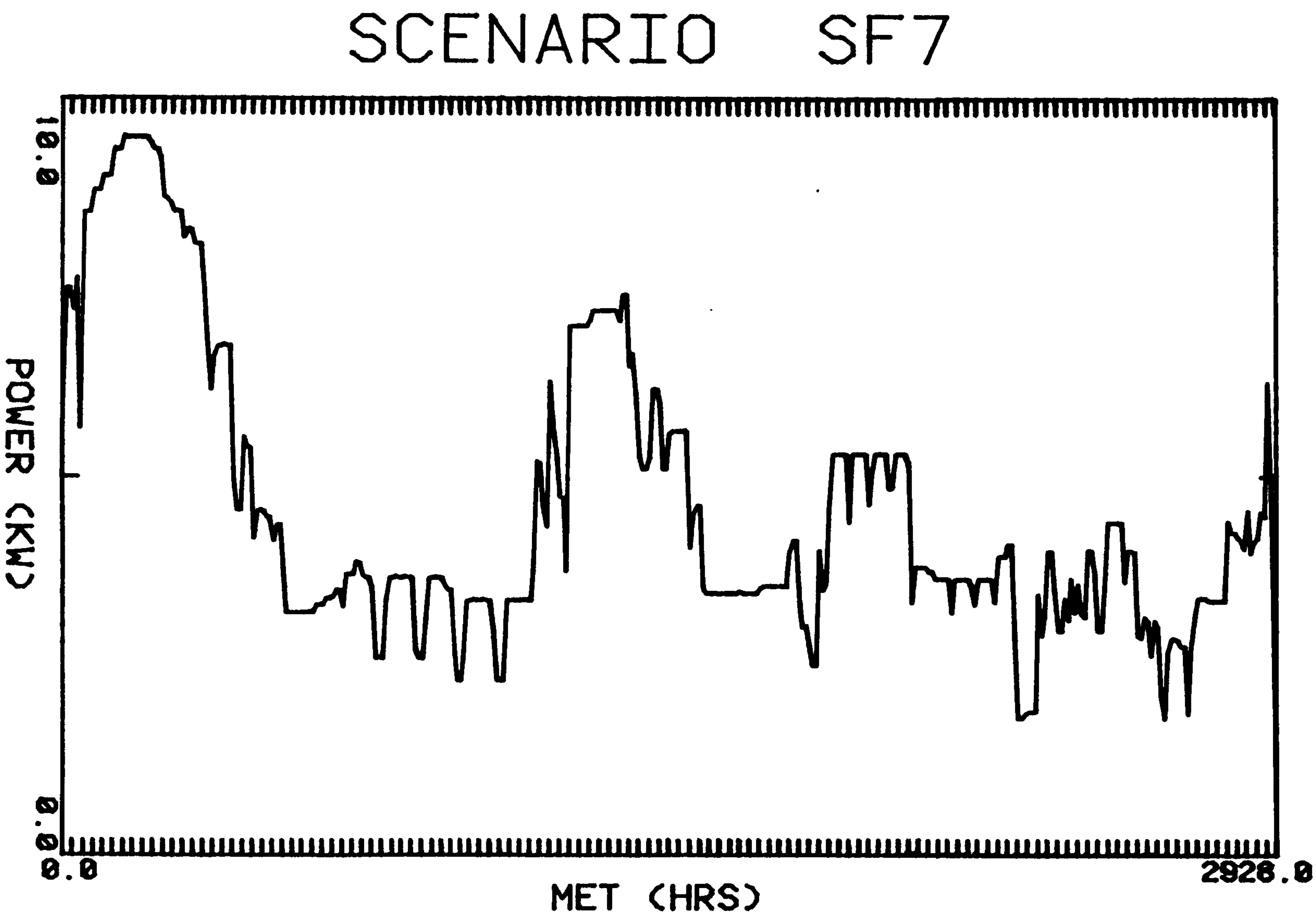


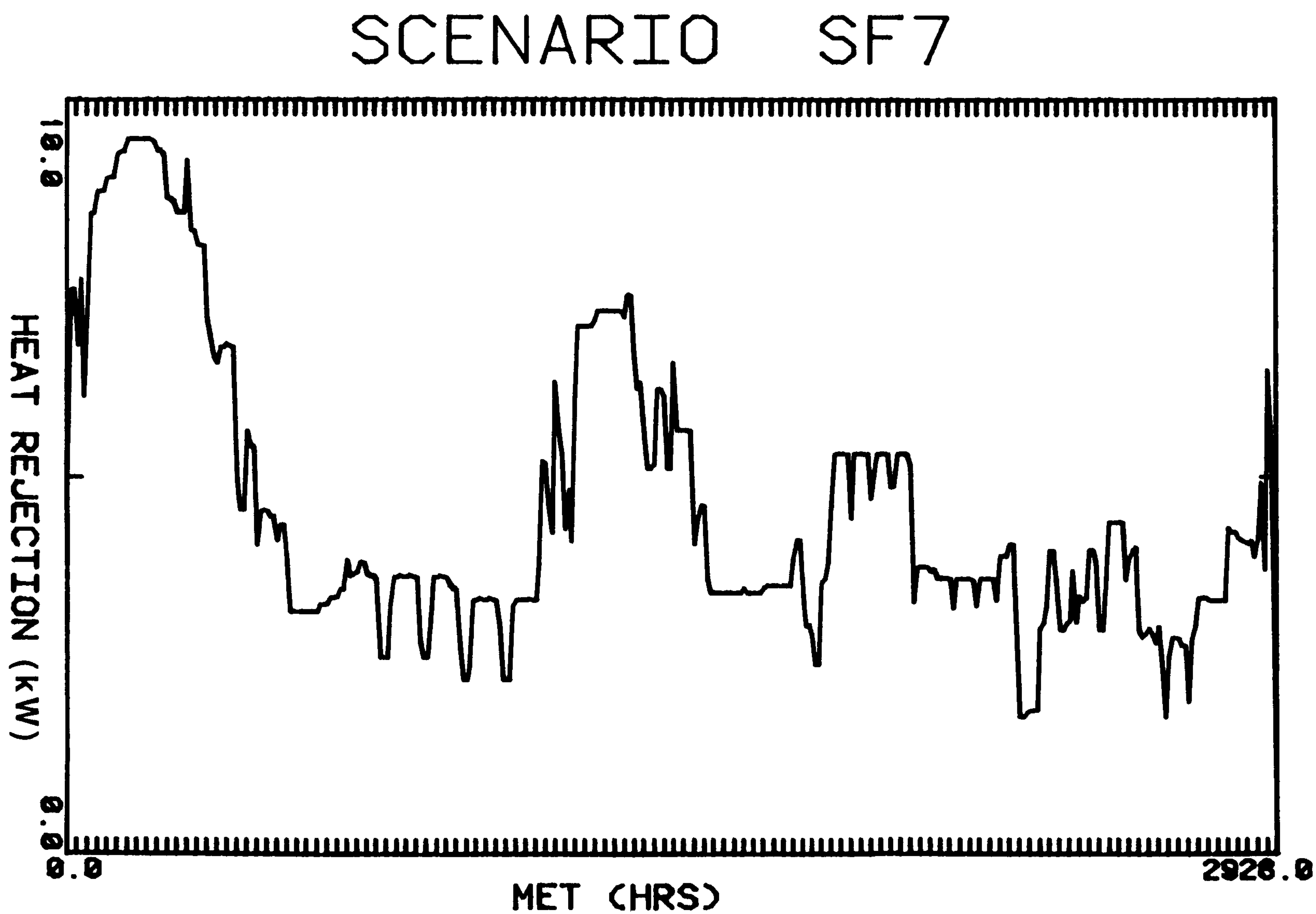
SCENARIO SF5



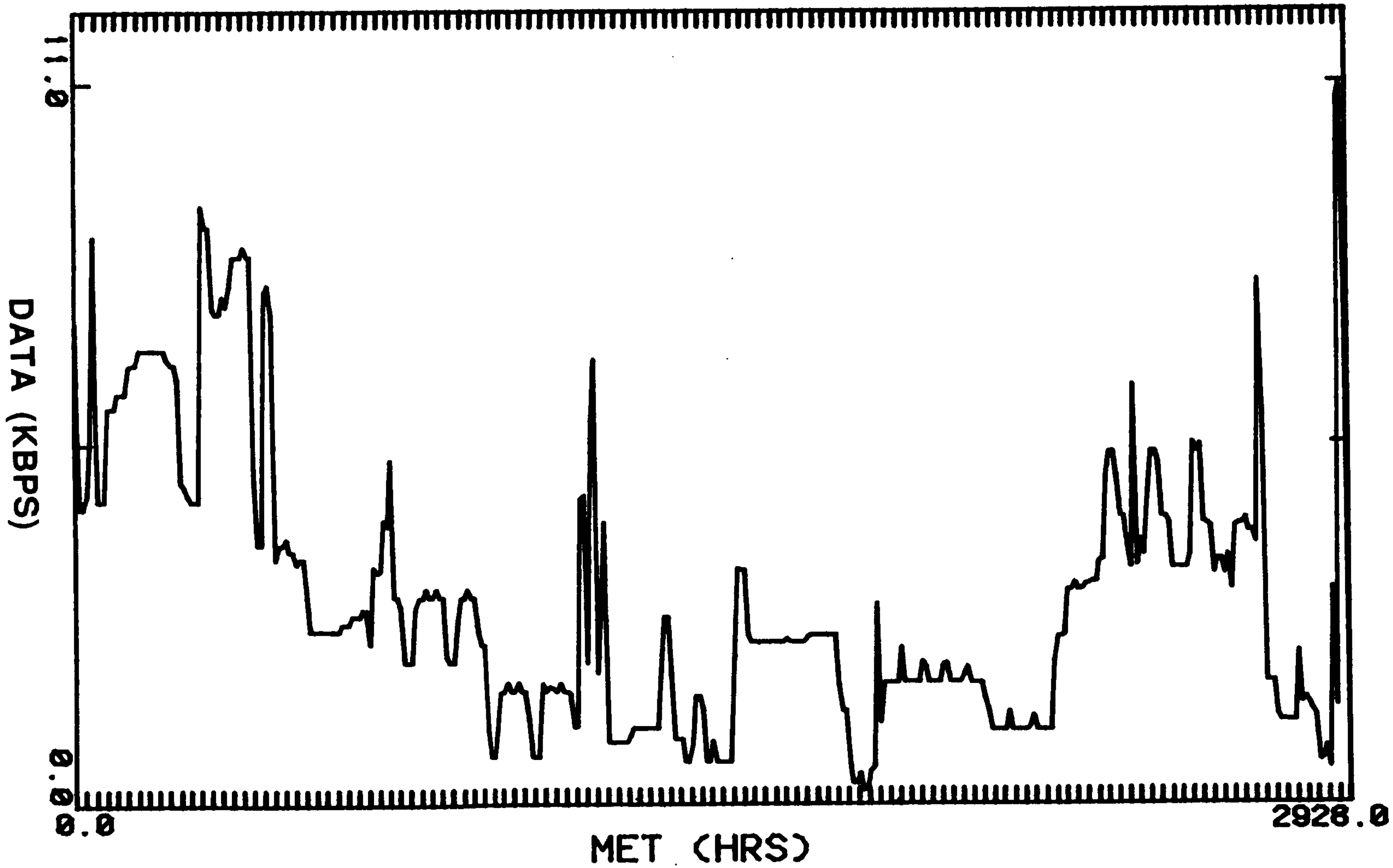
SCENARIO SF6



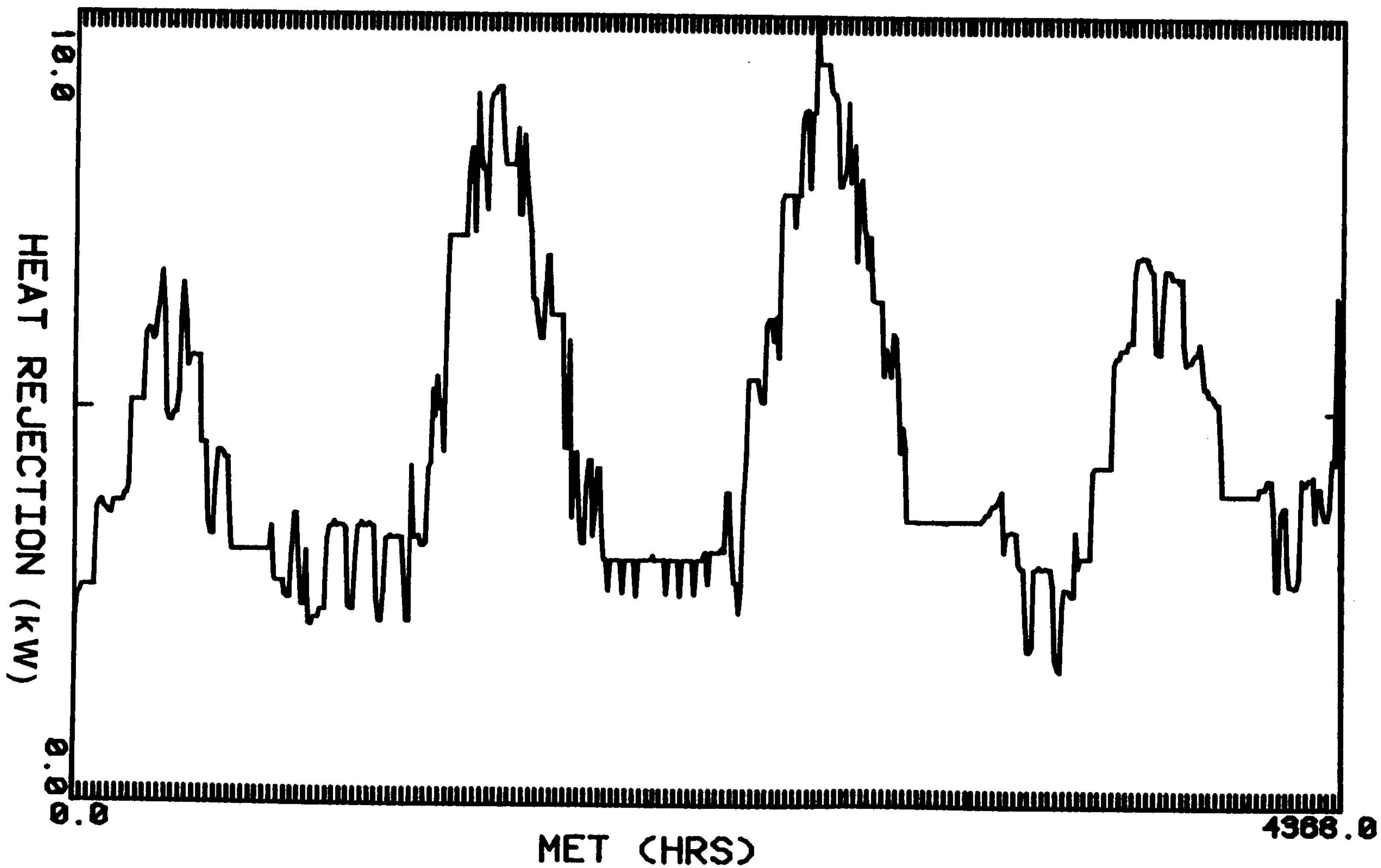

SCENARIO SF7
10.0
0.0
POWER (KW)
0.0
2928.0
MET (HRS)


SCENARIO SF7
10.0
0.0
HEAT REJECTION (kW)
0.0
2926.0
MET (HRS)

SCENARIO SF7



SCENARIO SF8



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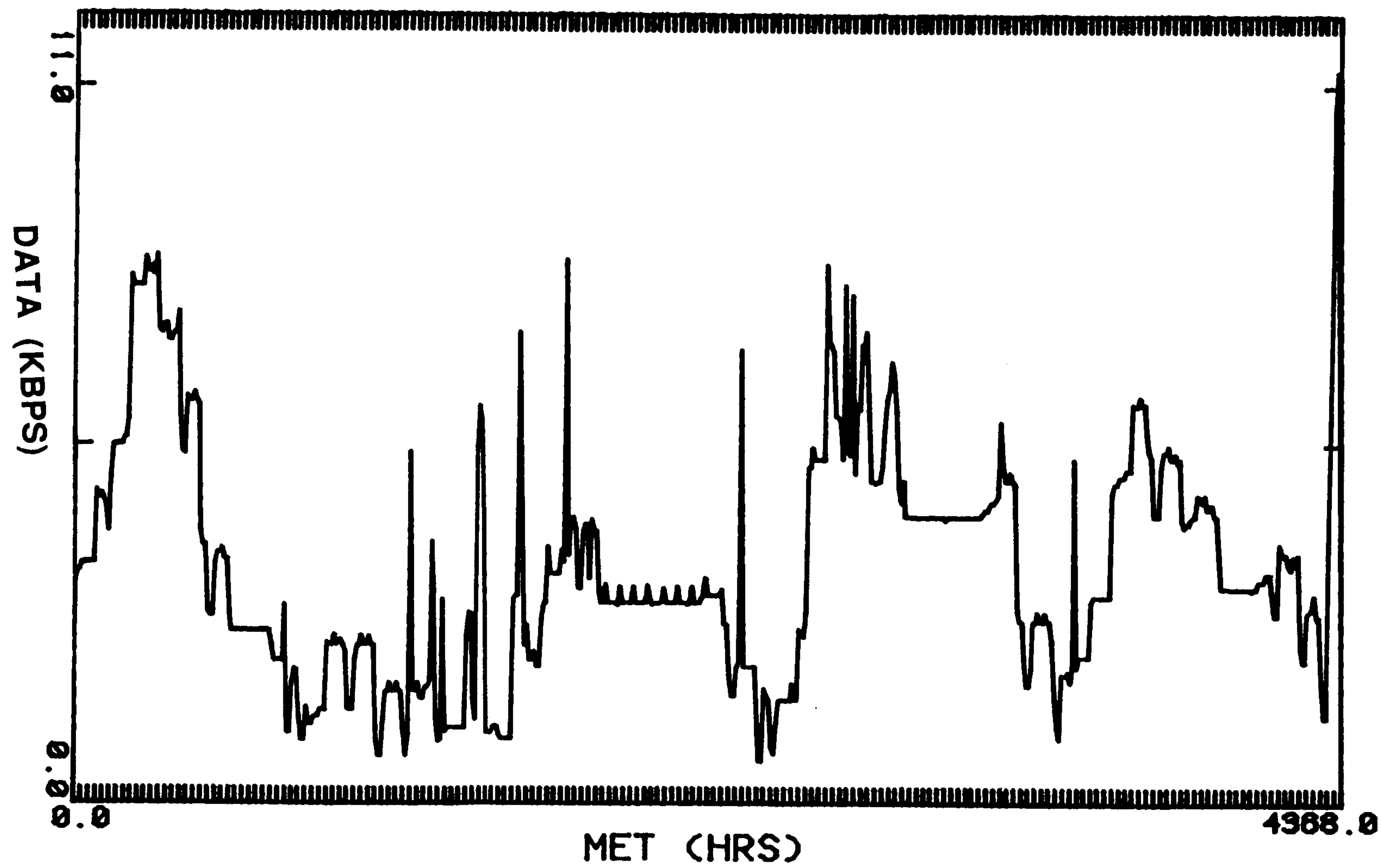
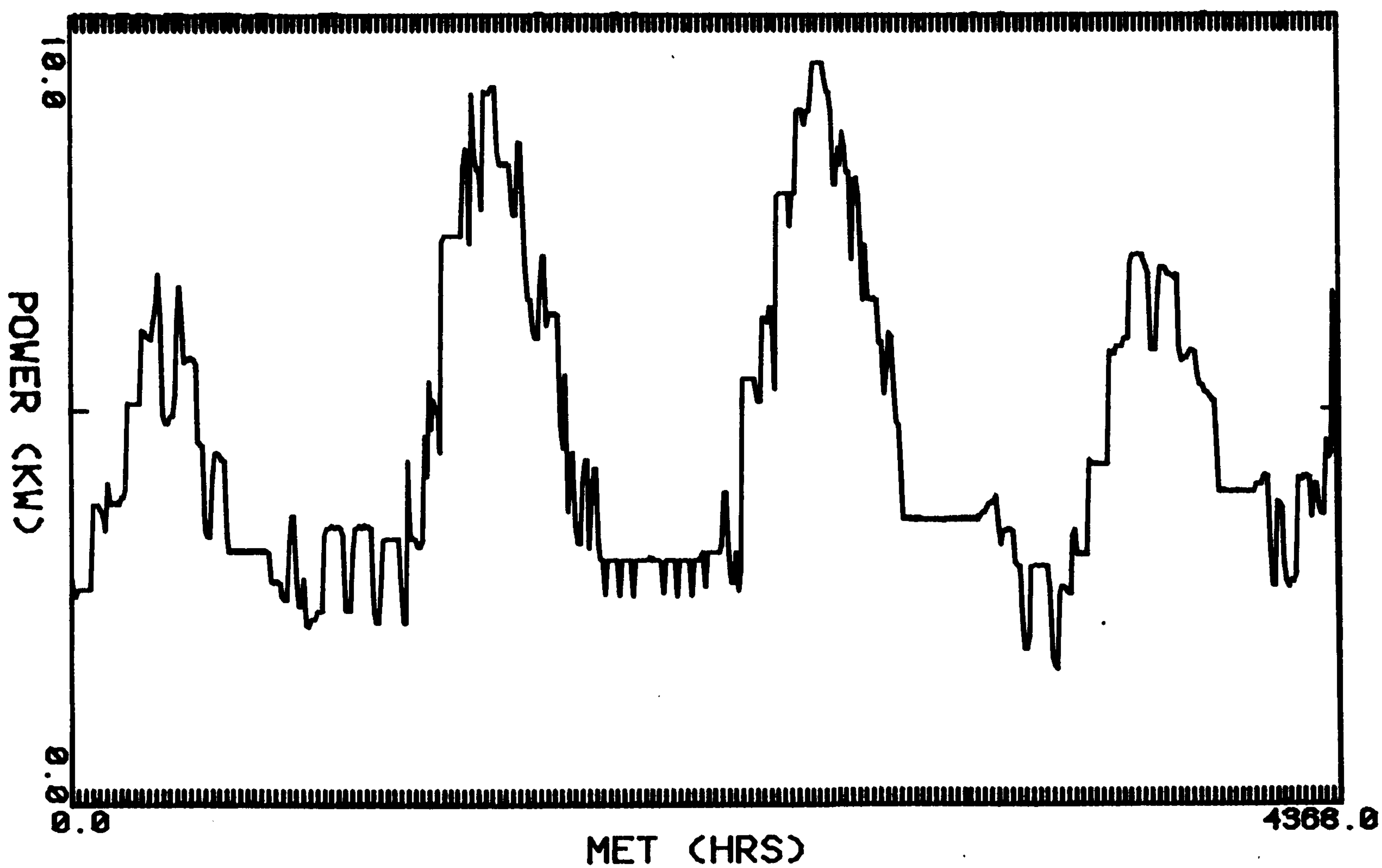
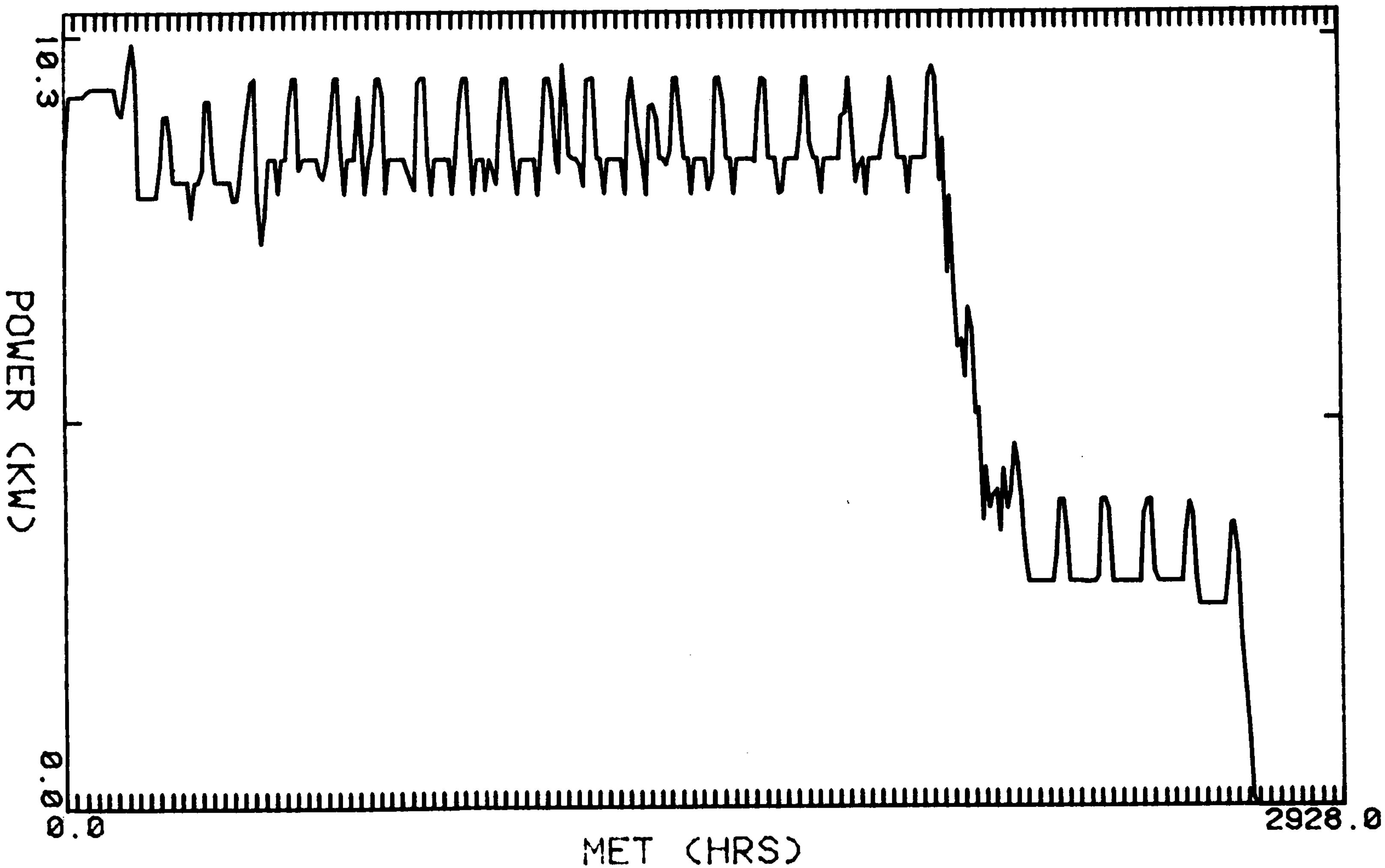
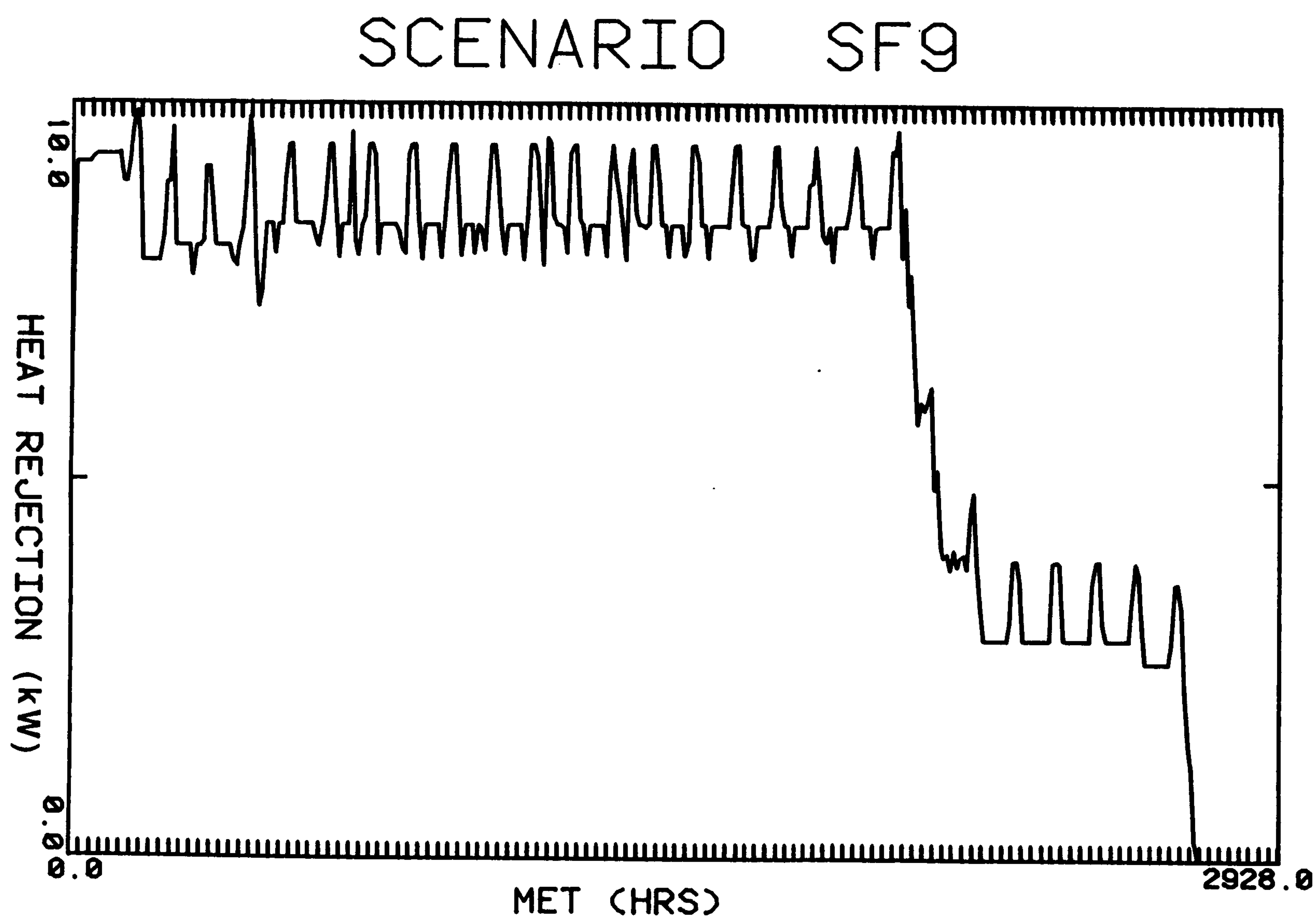


SCENARIO SF8

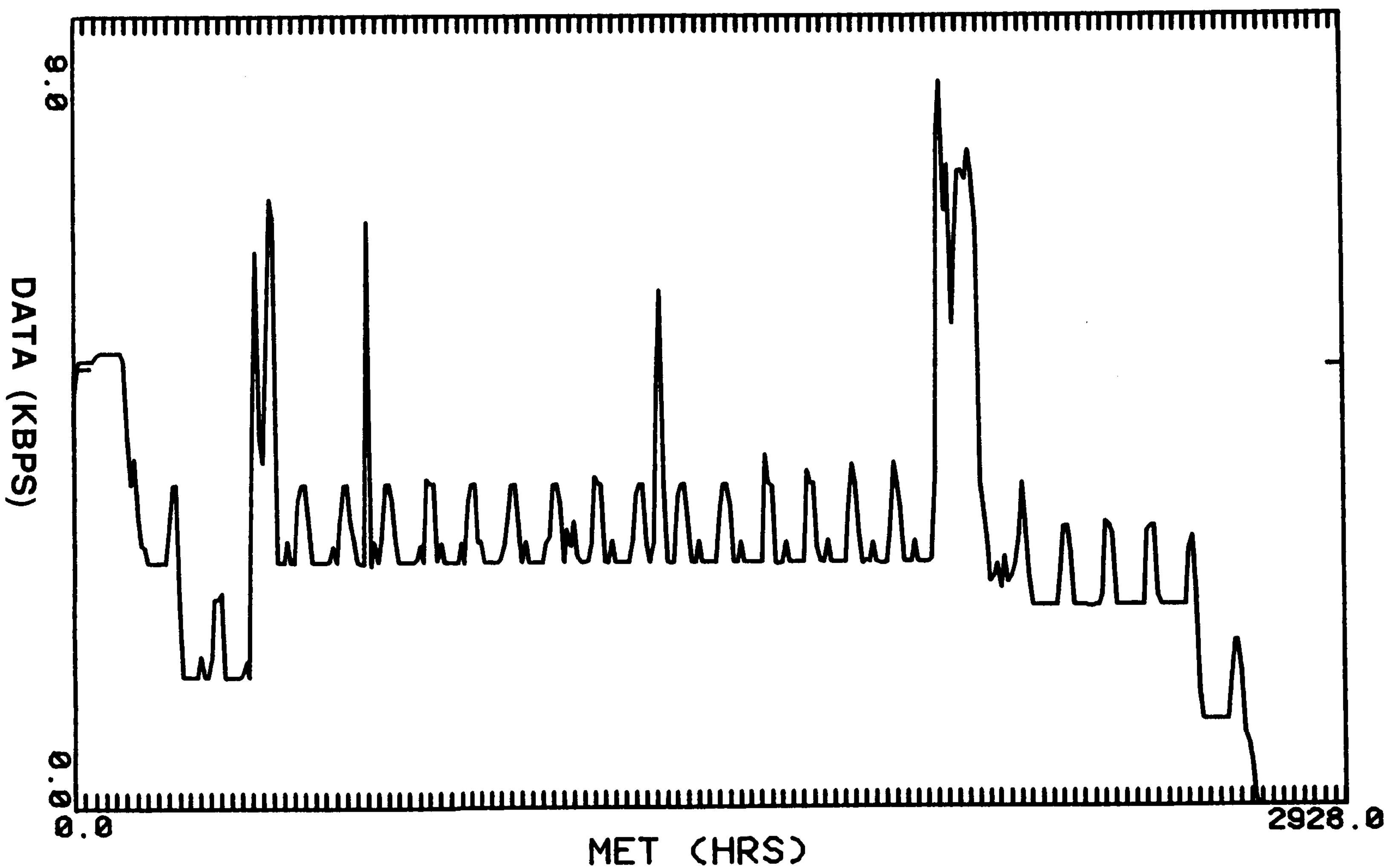


SCENARIO SF9




SCENARIO SF9
10.0
0.0
HEAT REJECTION (kW)
0.0
2928.0
MET (HRS)

SCENARIO SF9



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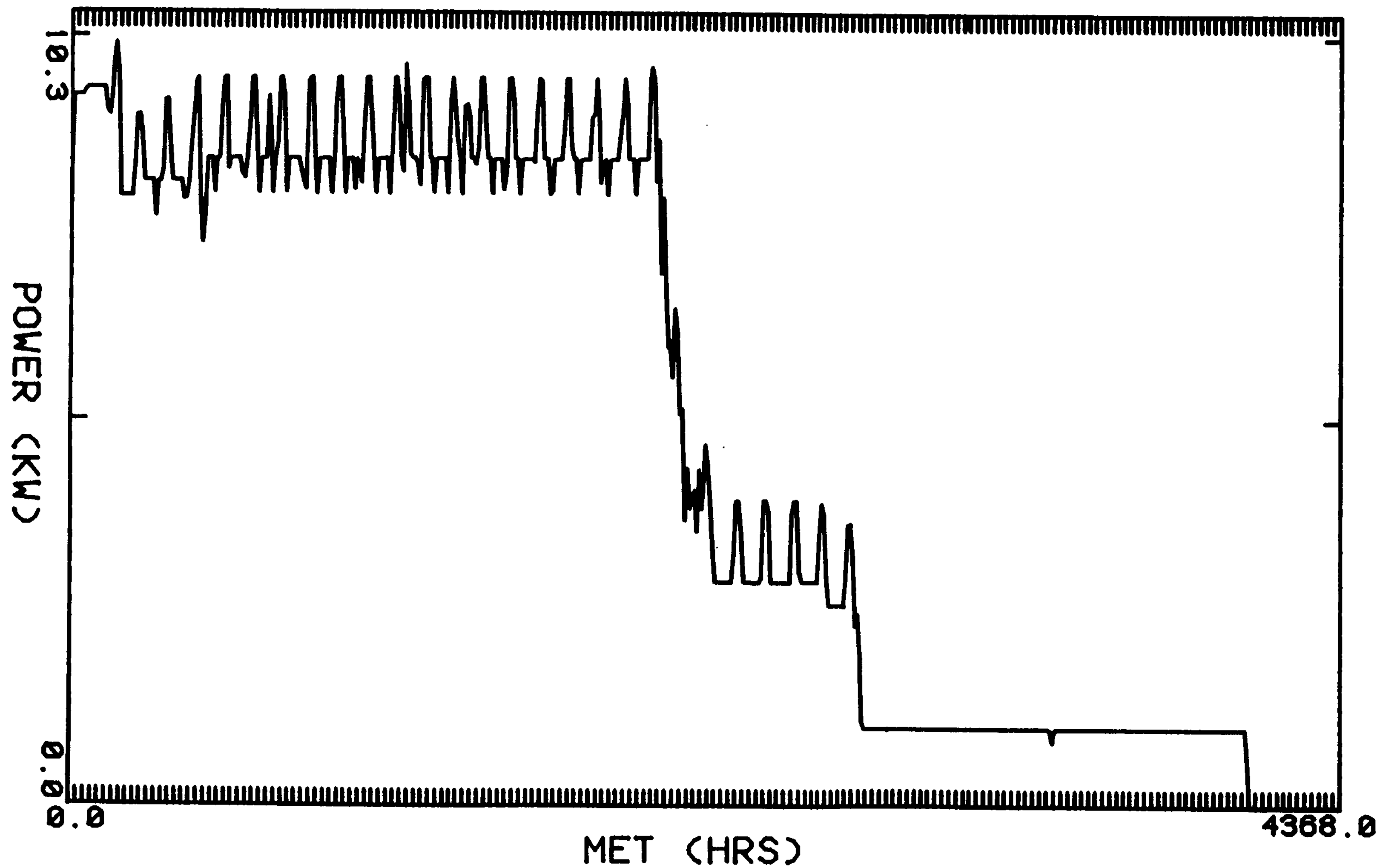
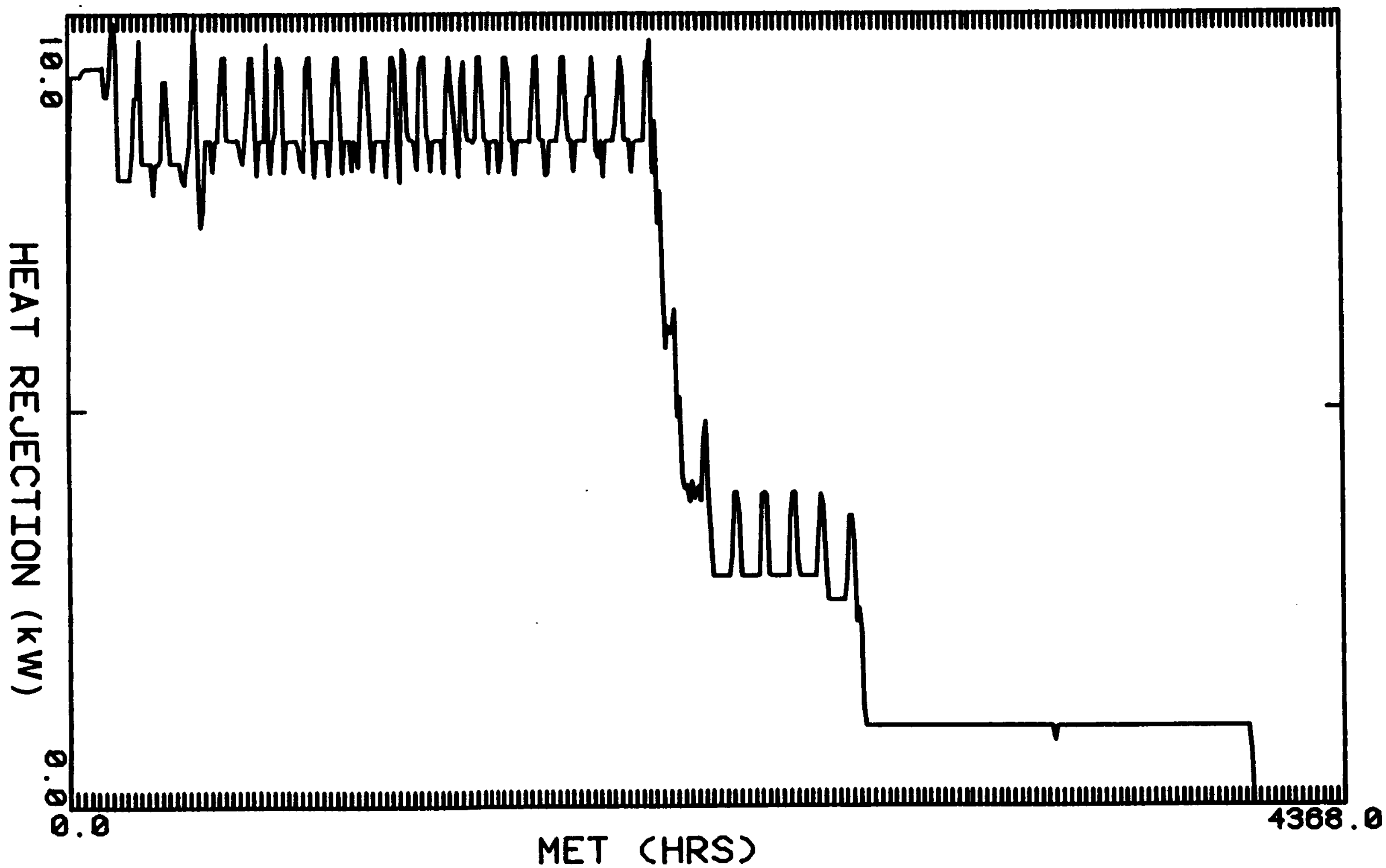
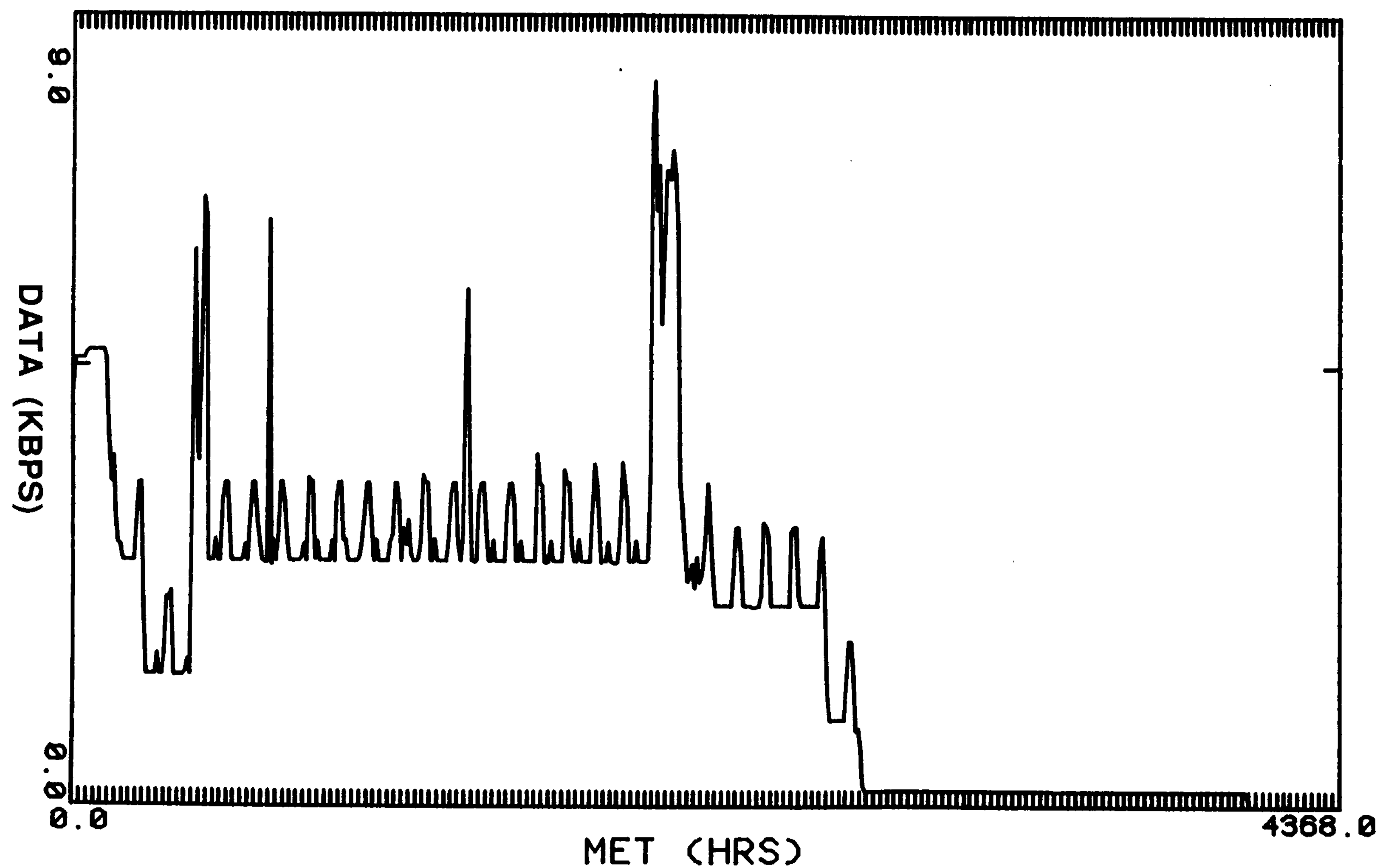


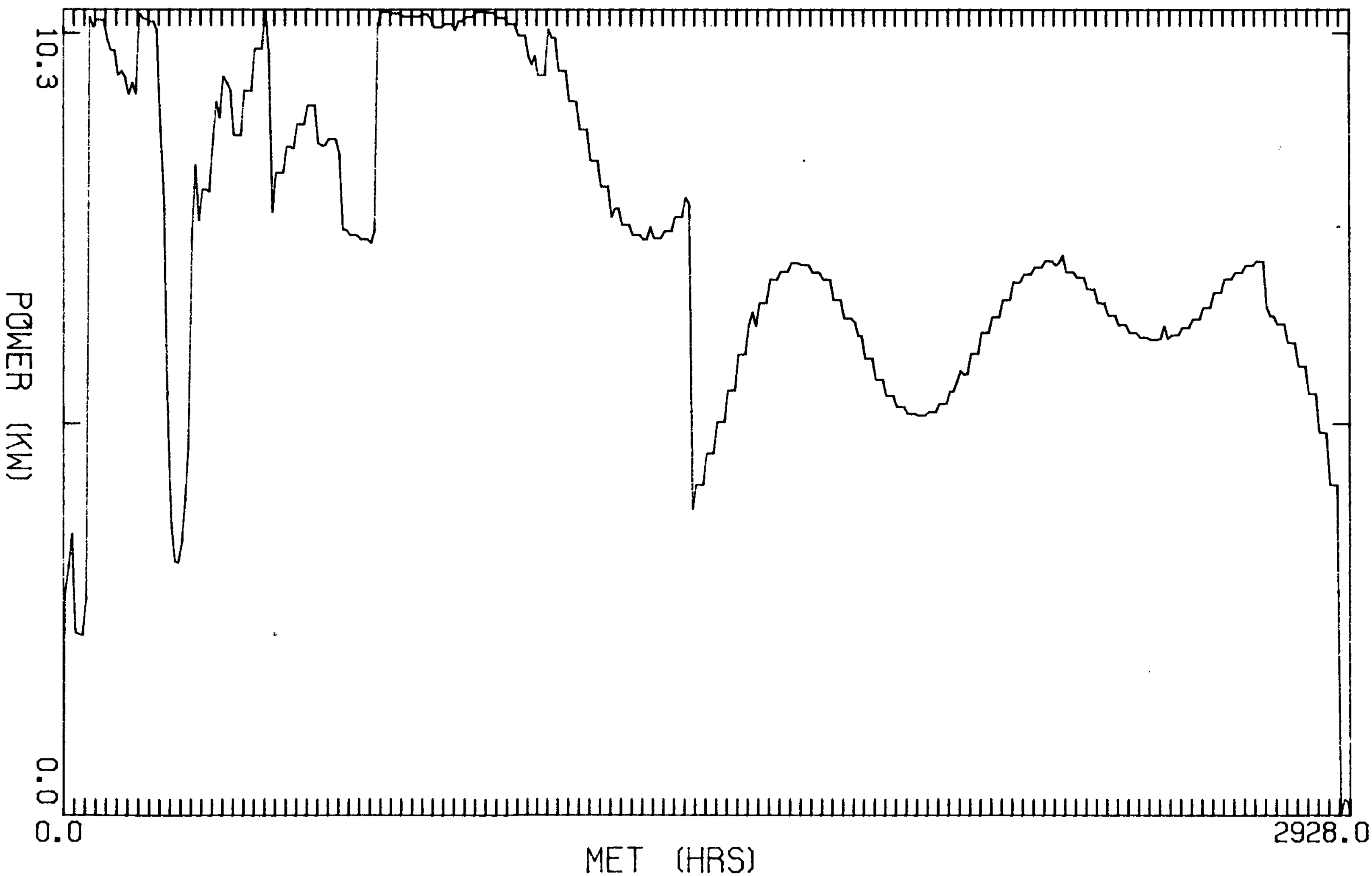
SCENARIO SF10

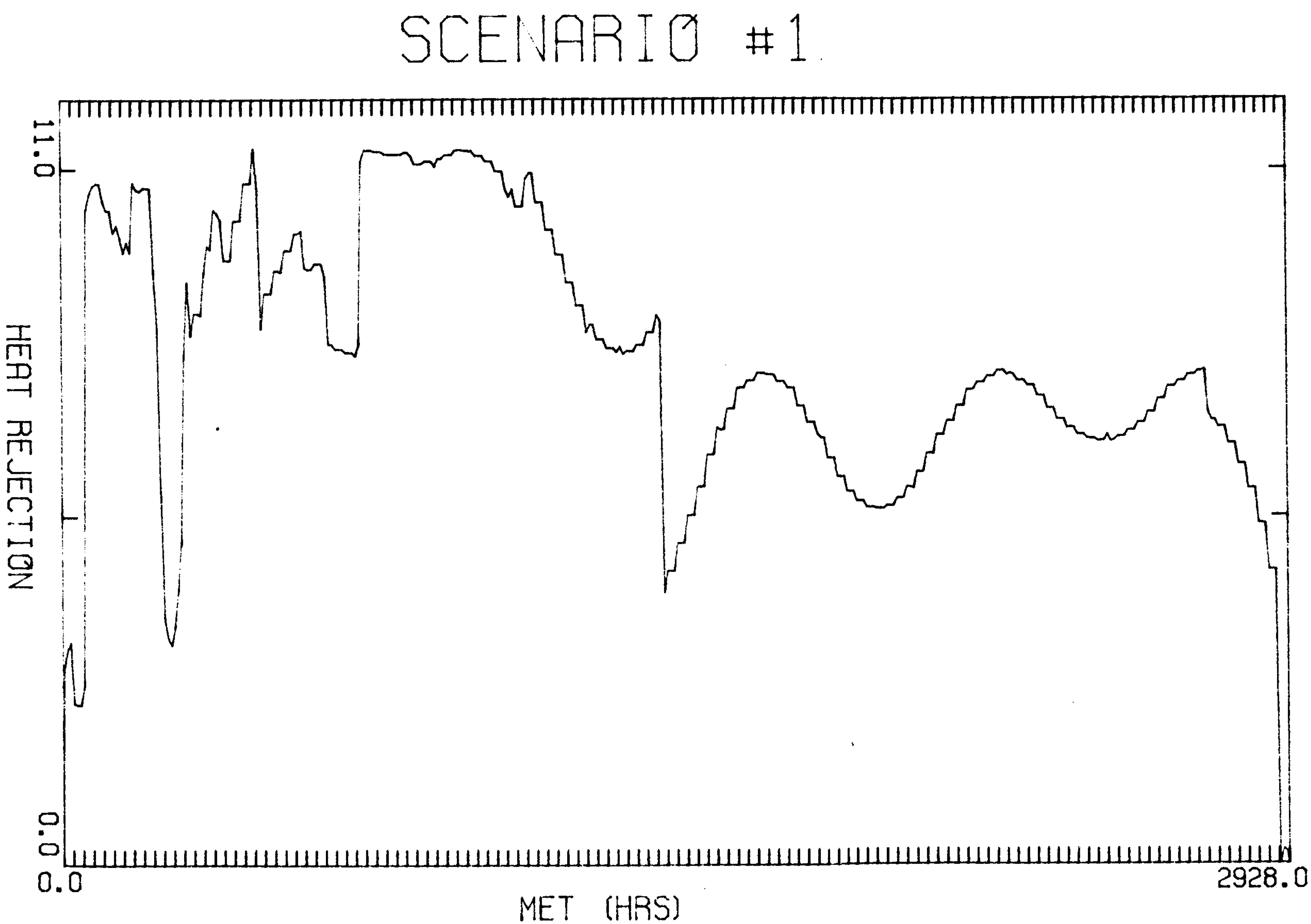


SCENARIO SF10



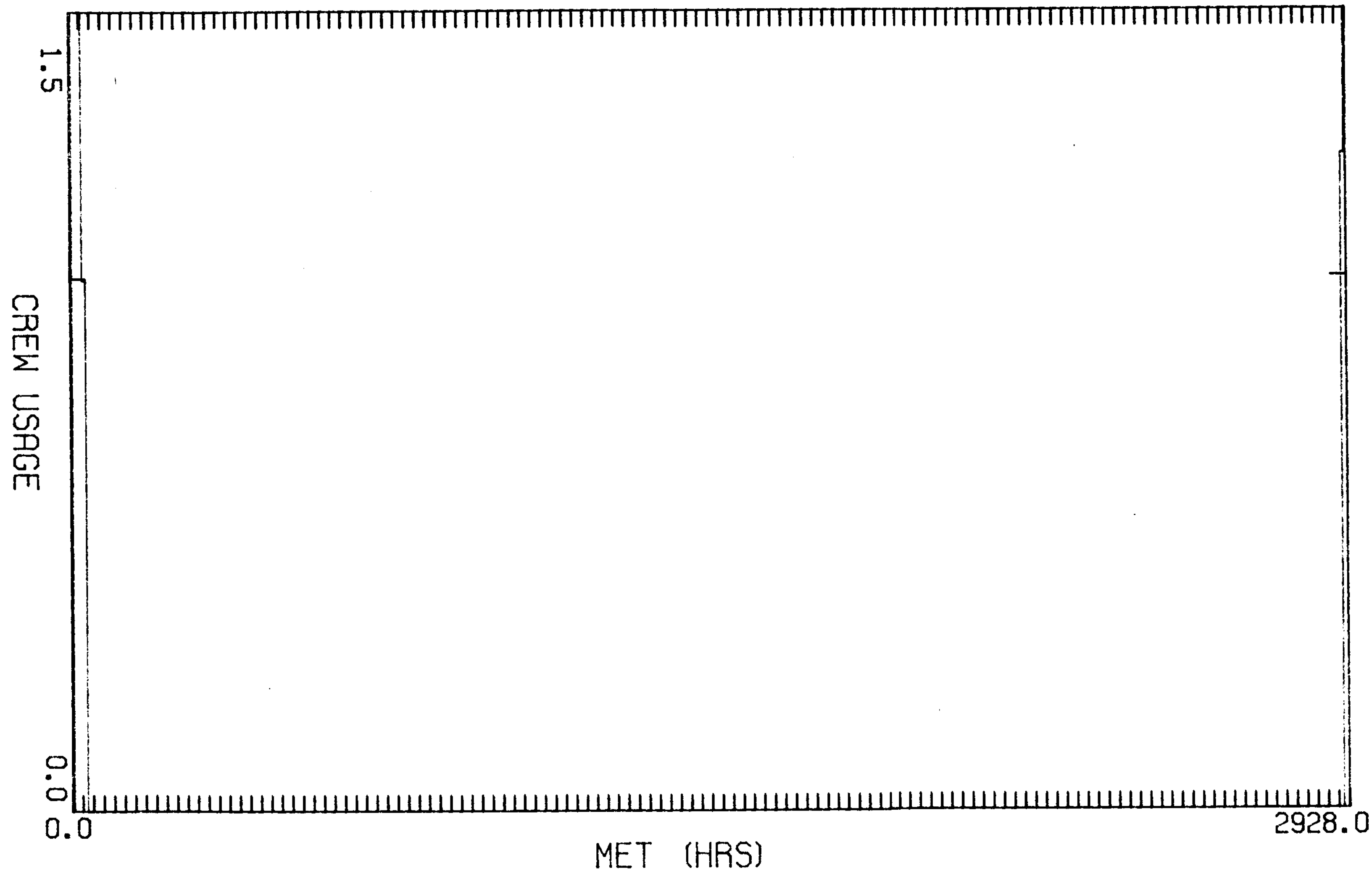
SCENARIØ #1



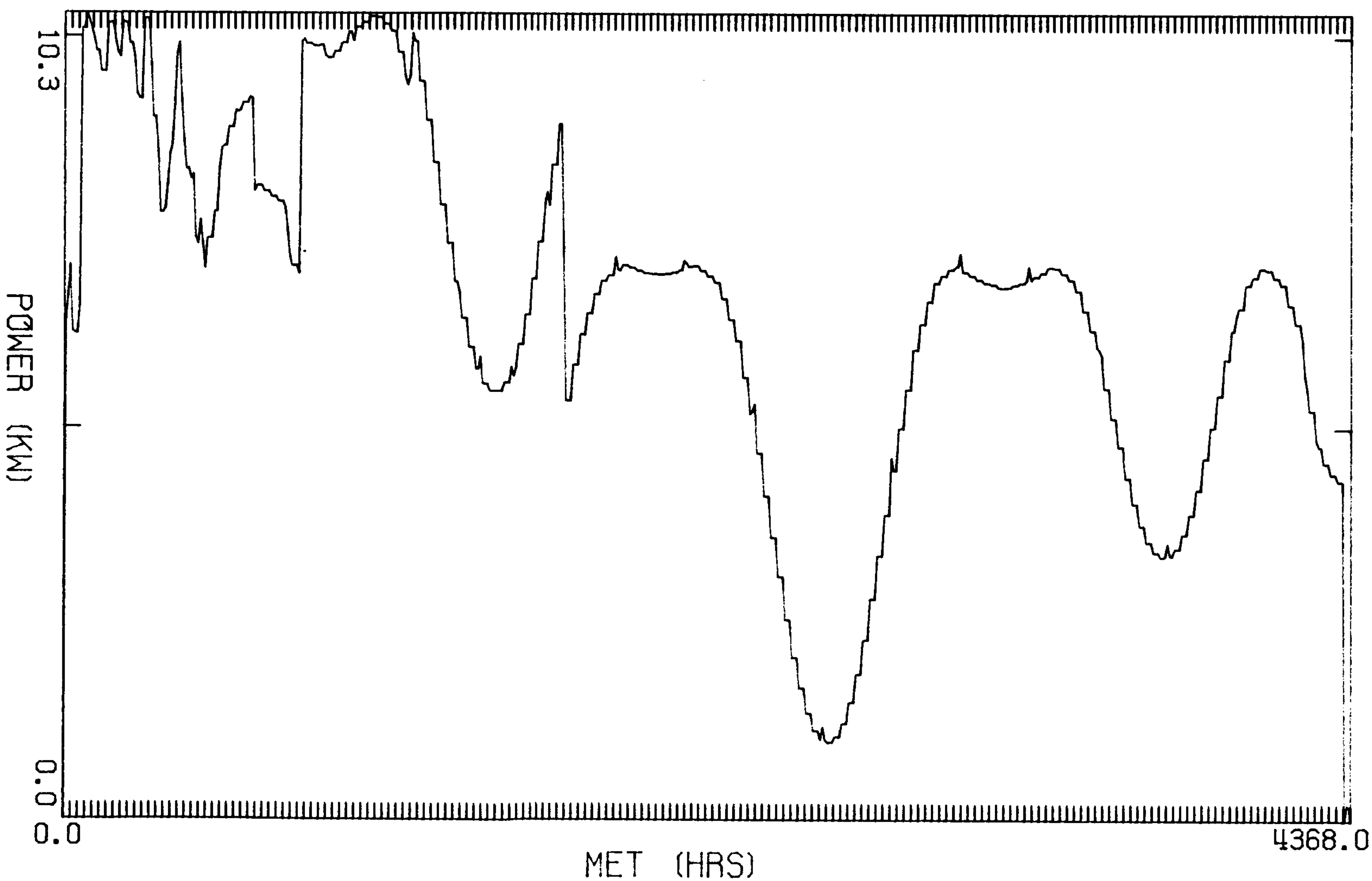

SCENARIO #1
11.0
0.0
HEAT REJECTION
0.0
2928.0
MET (HRS)

SCENARIO #1

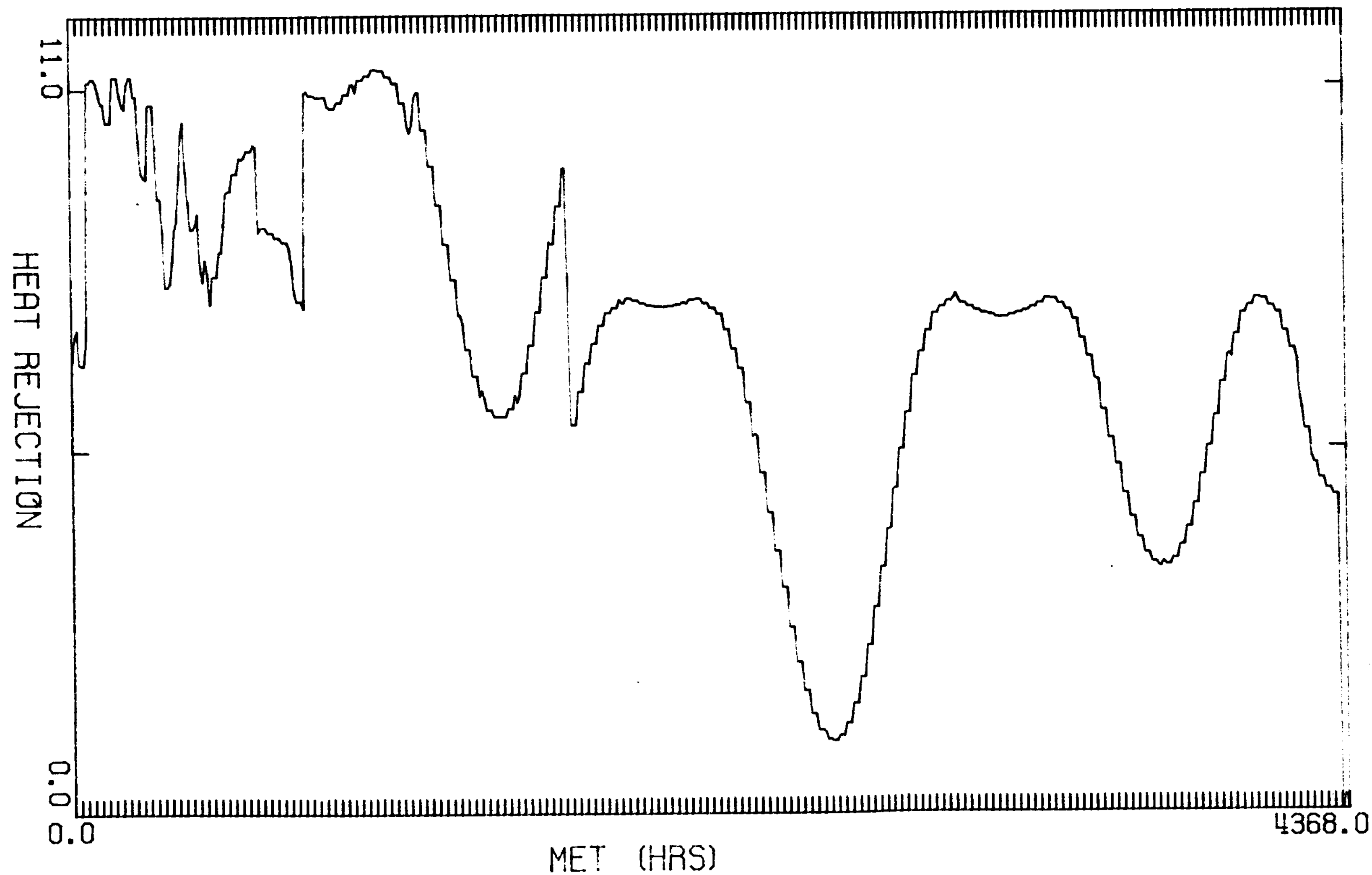
SCENARIØ #1



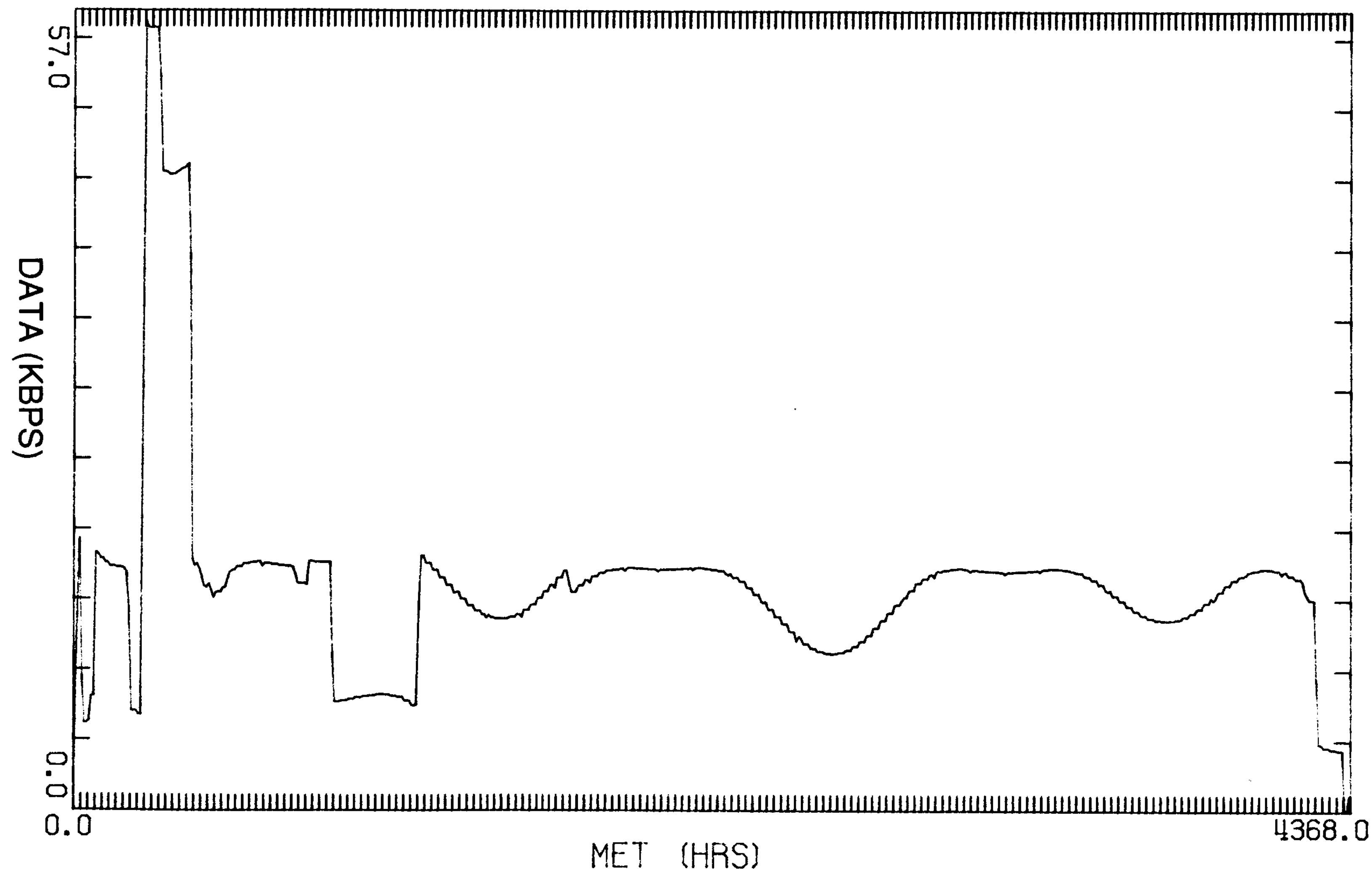
SCENARIØ #2



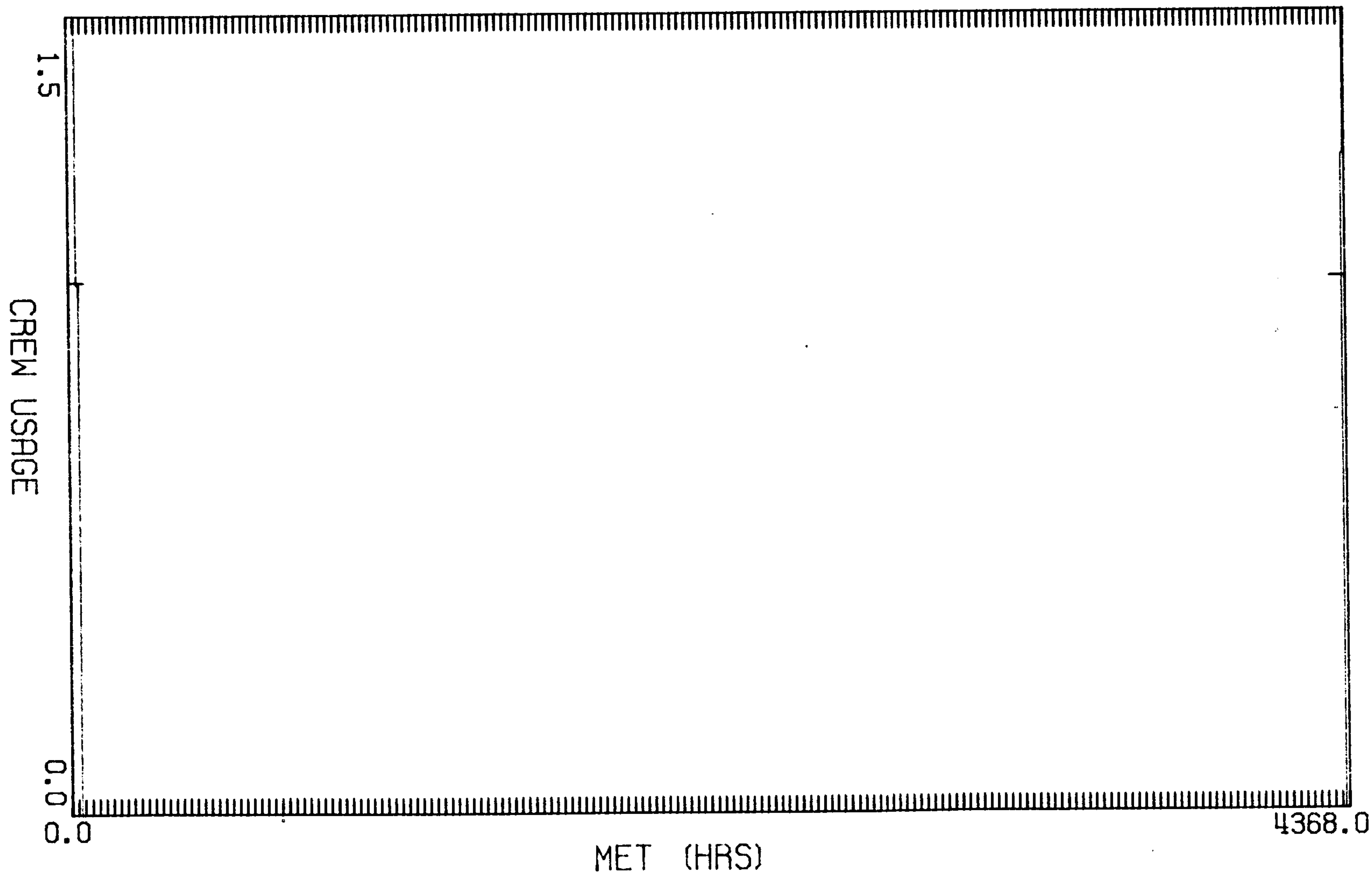
SCENARIO #2

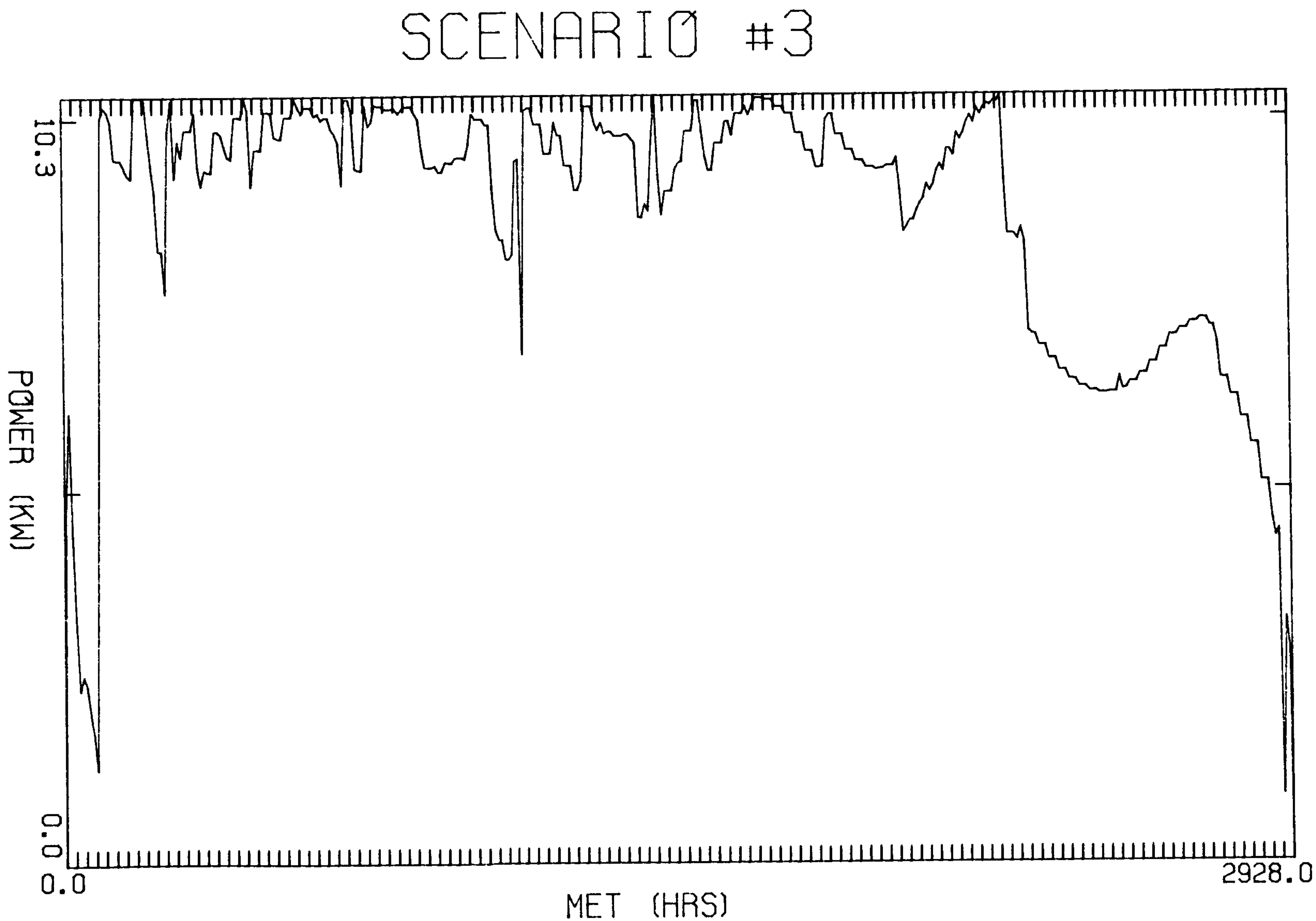


SCENARIO #2



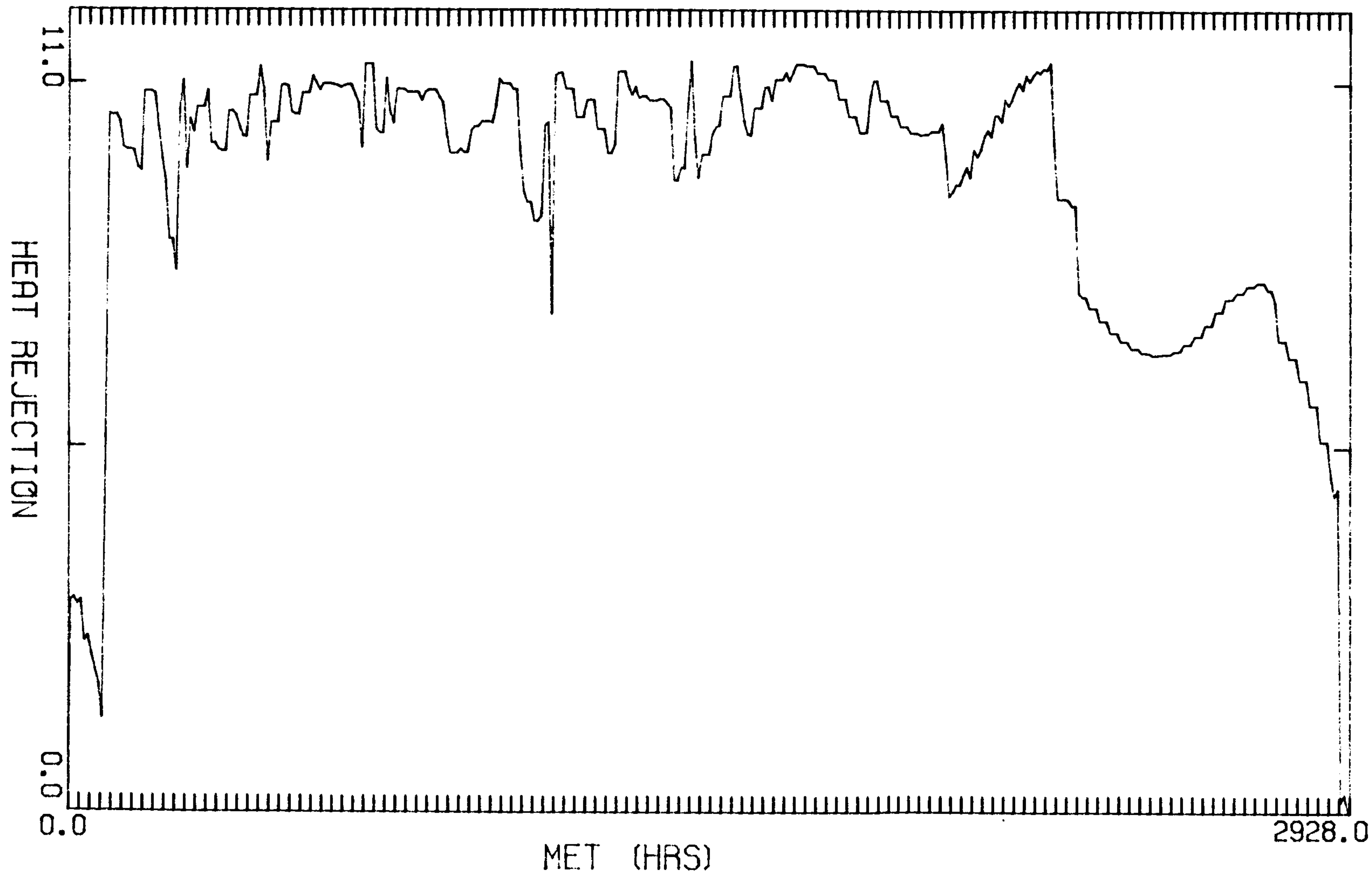
SCENARIØ #2



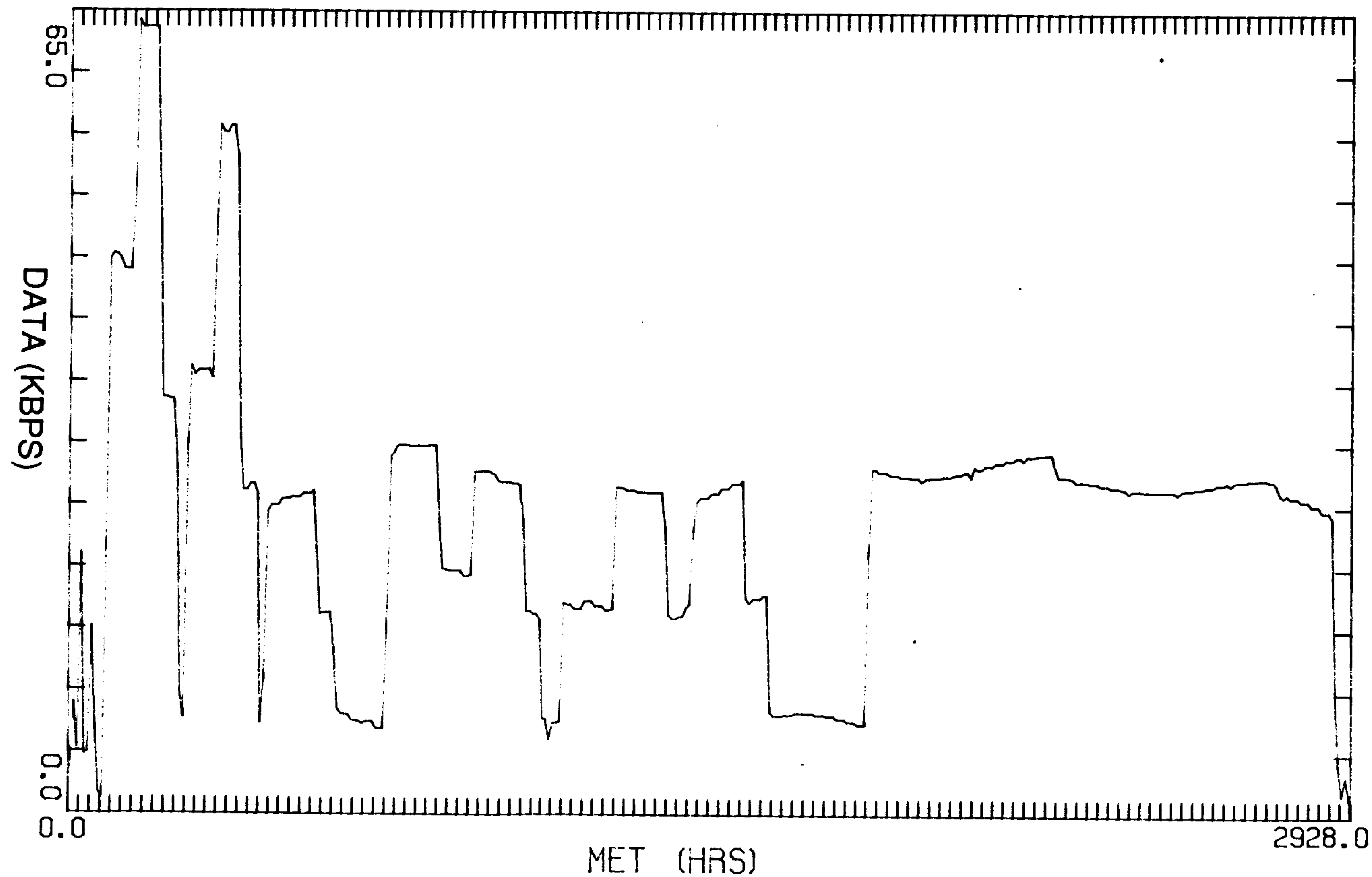


SCENARIØ #3
10.3
0.0
POWER (KW)
0.0
2928.0
MET (HRS)

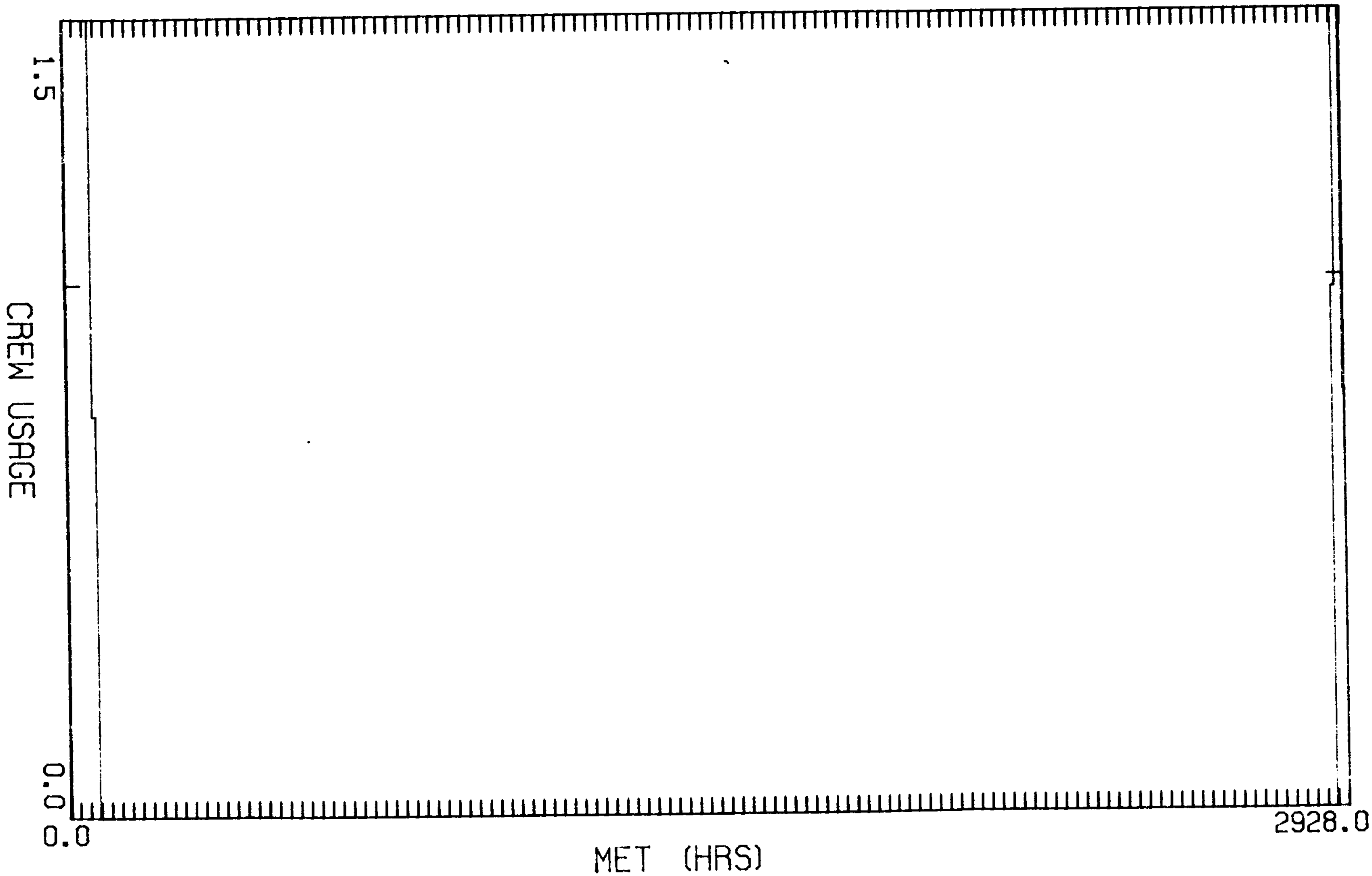
SCENARIØ #3



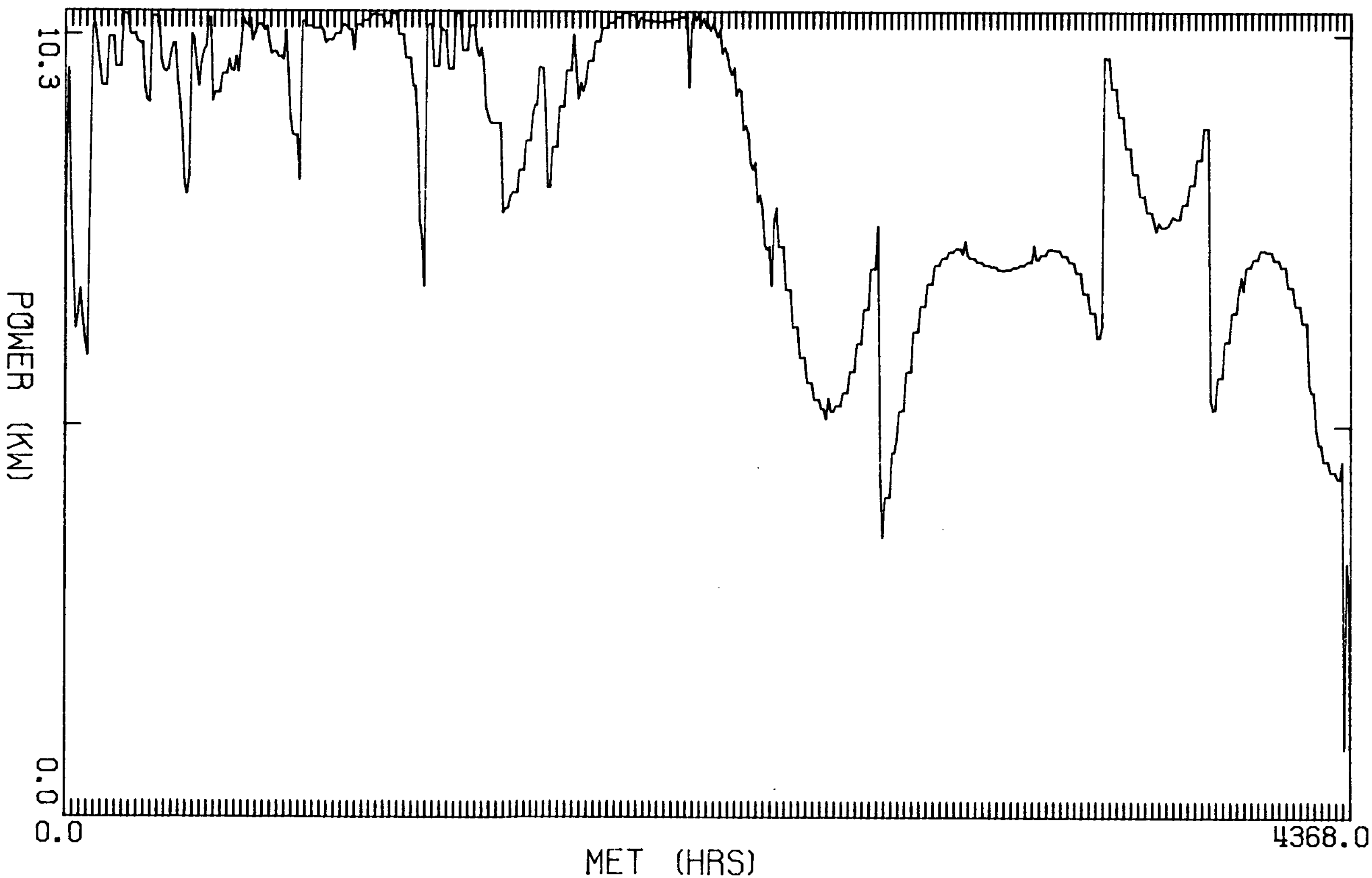
SCENARIØ #3

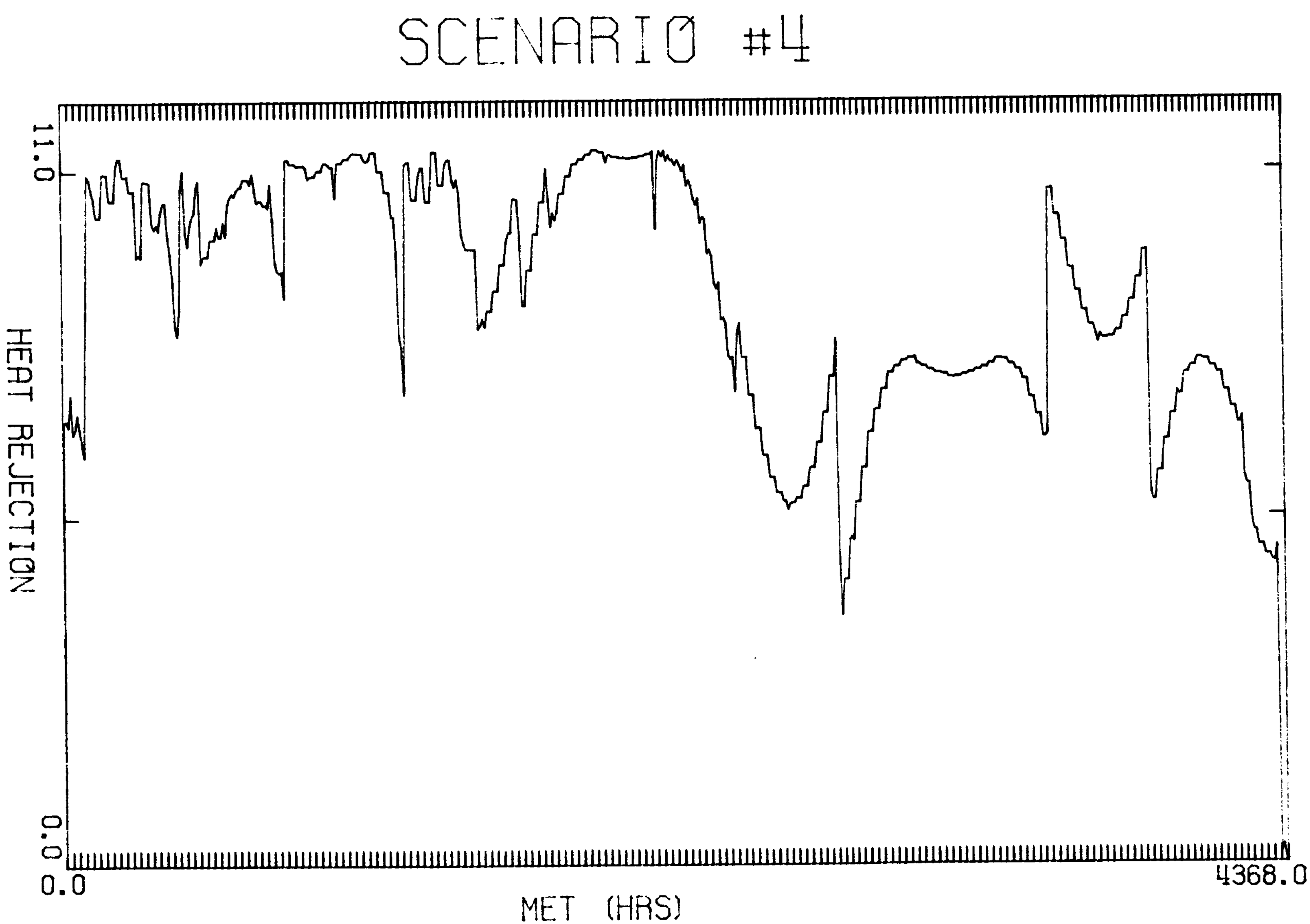


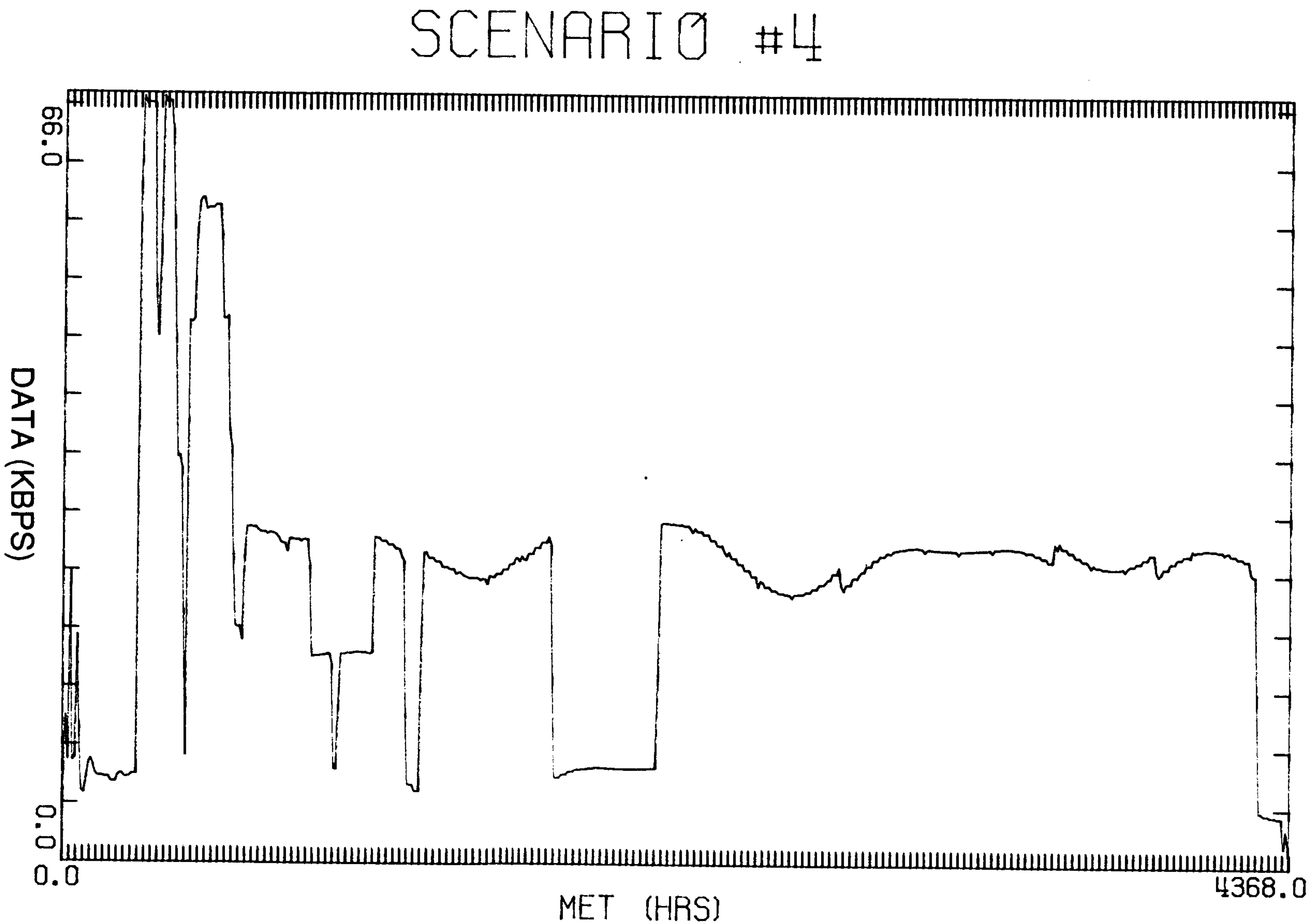
SCENARIO #3



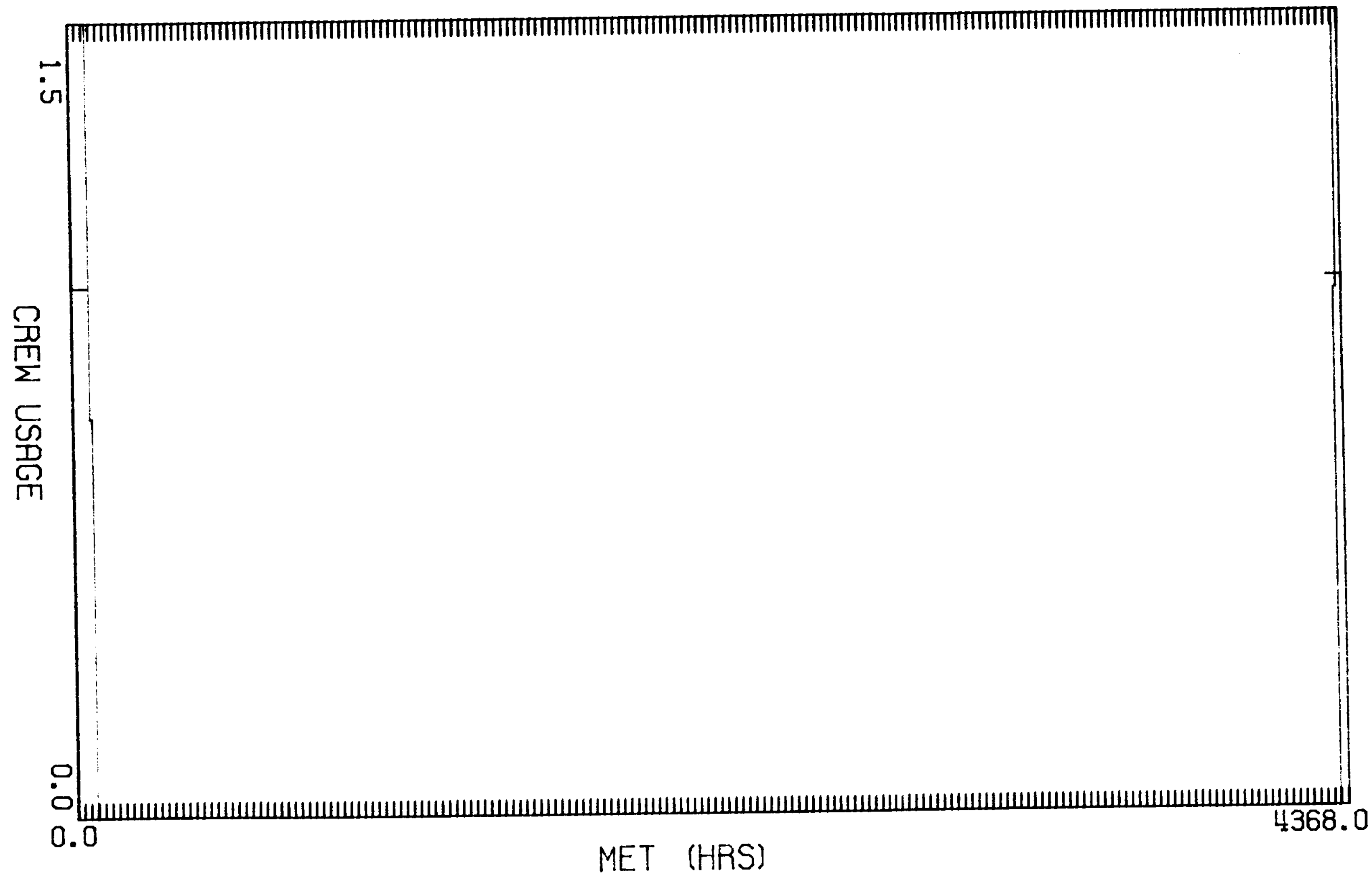
SCENARIØ #4



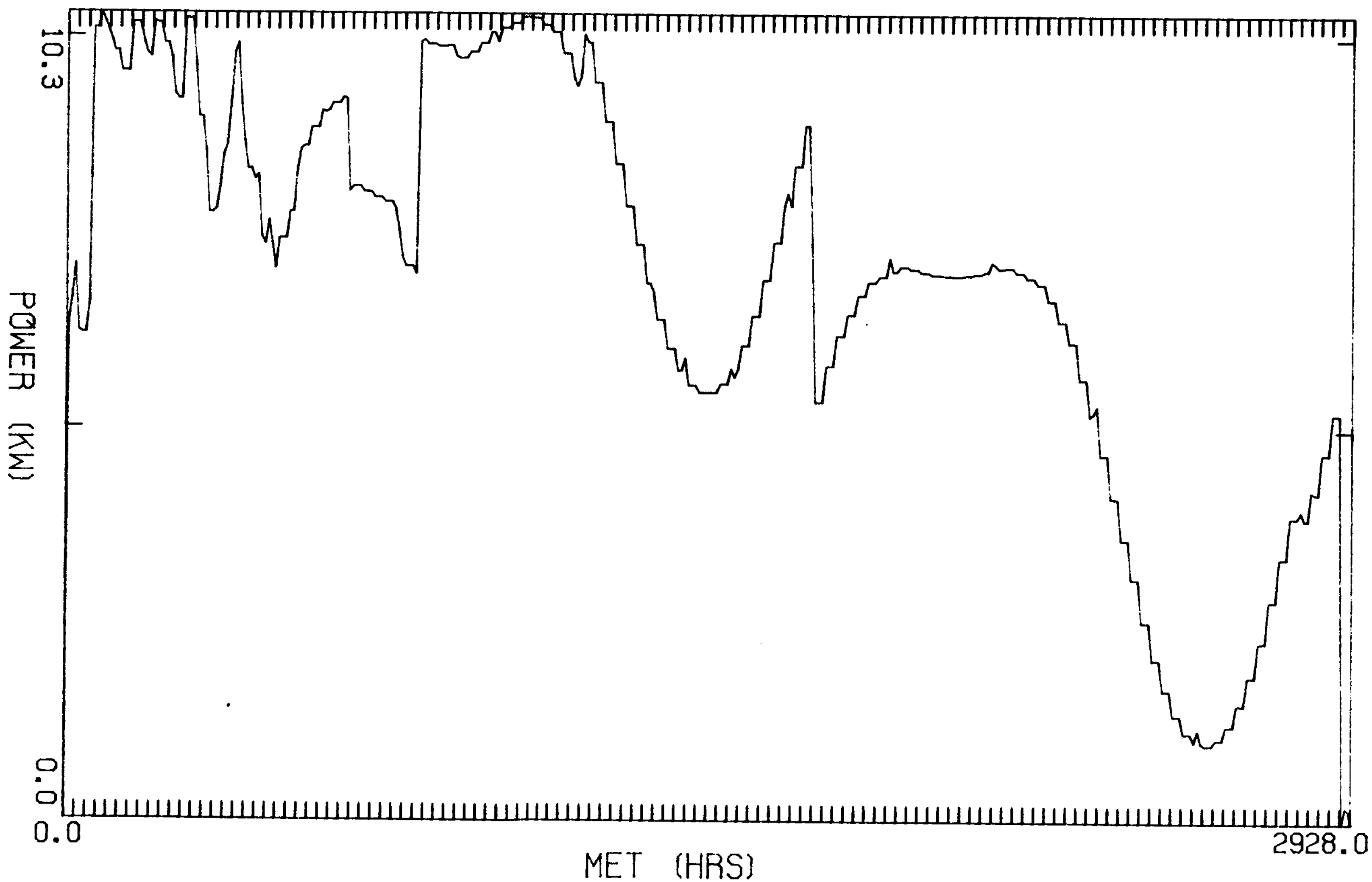

SCENARIØ #4
11.0
0.0
HEAT REJECTIØN
0.0
4368.0
MET (HRS)


SCENARIØ #4
DATA (KBPS)
66.0
0.0
0.0
4368.0
MET (HRS)

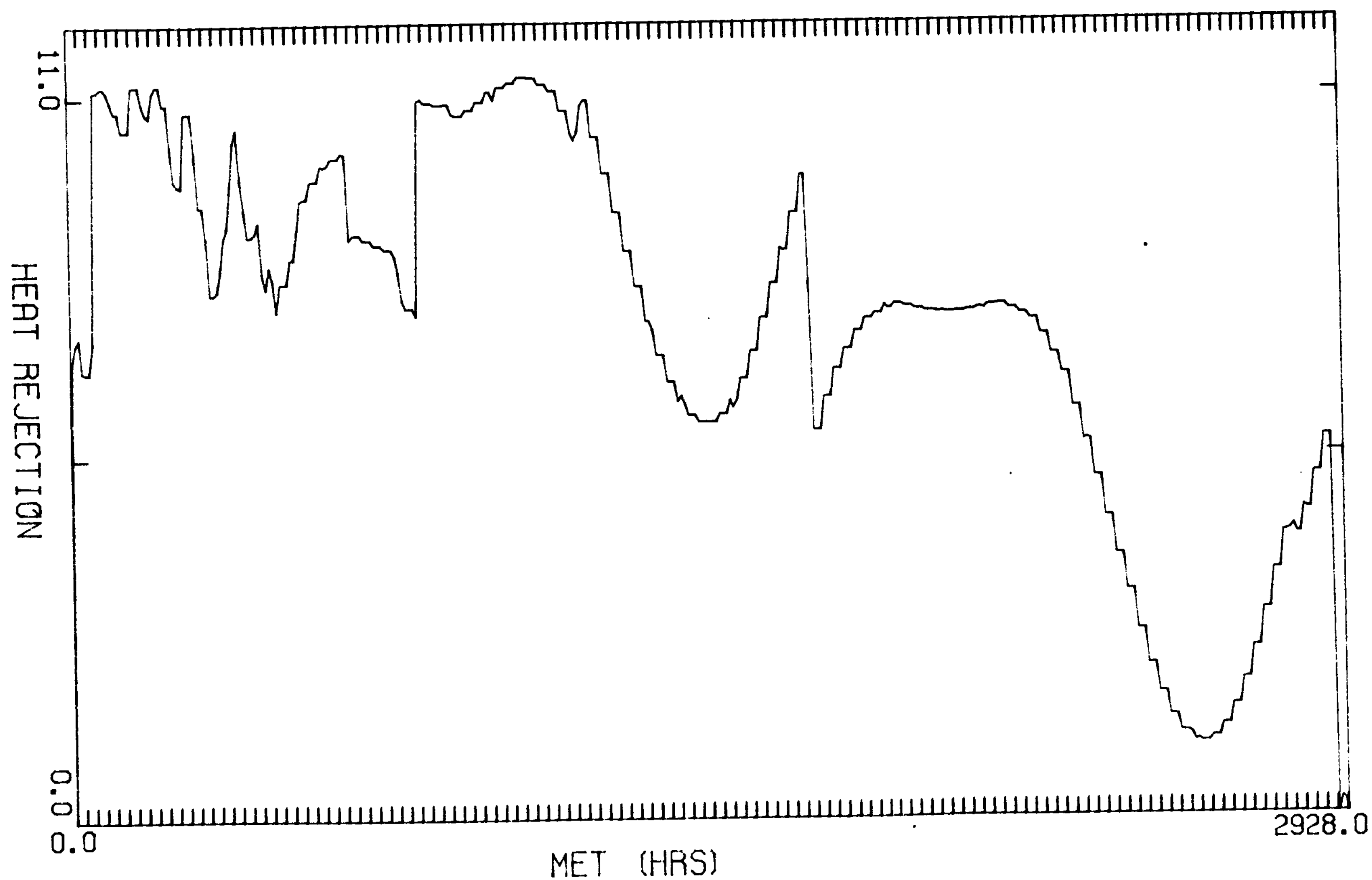
SCENARIØ #4



SCENARIØ #5



SCENARIO #5



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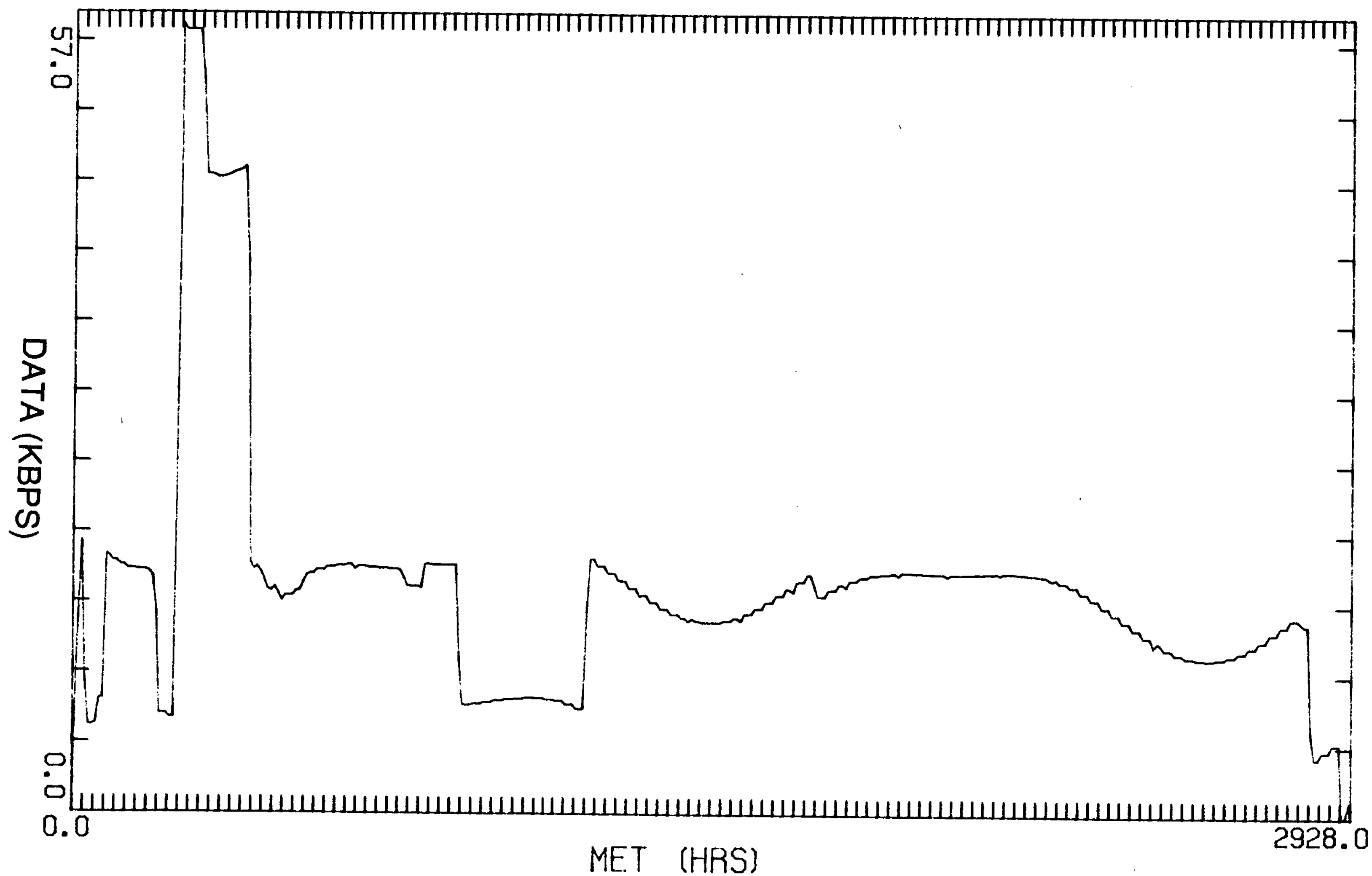
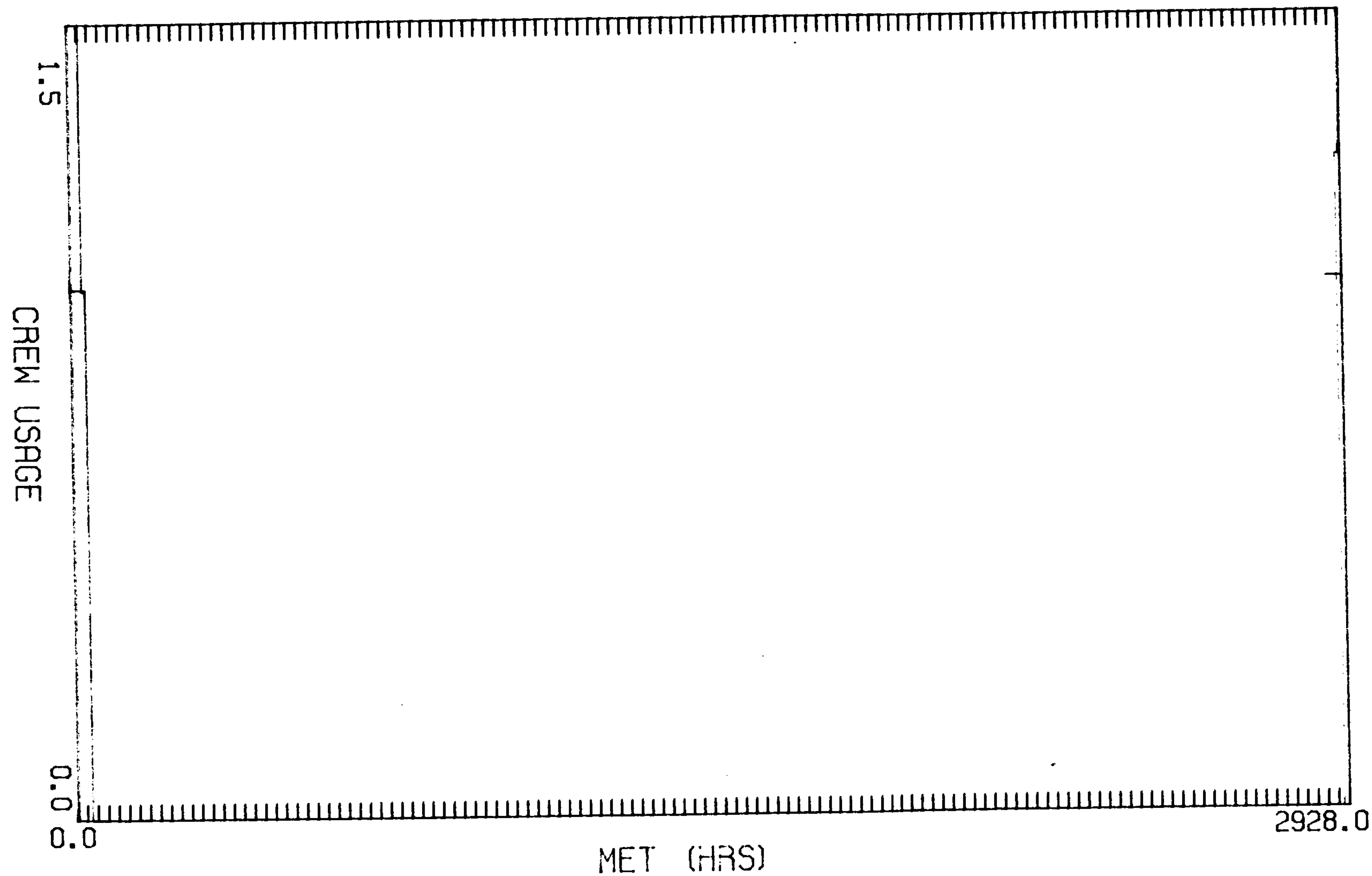
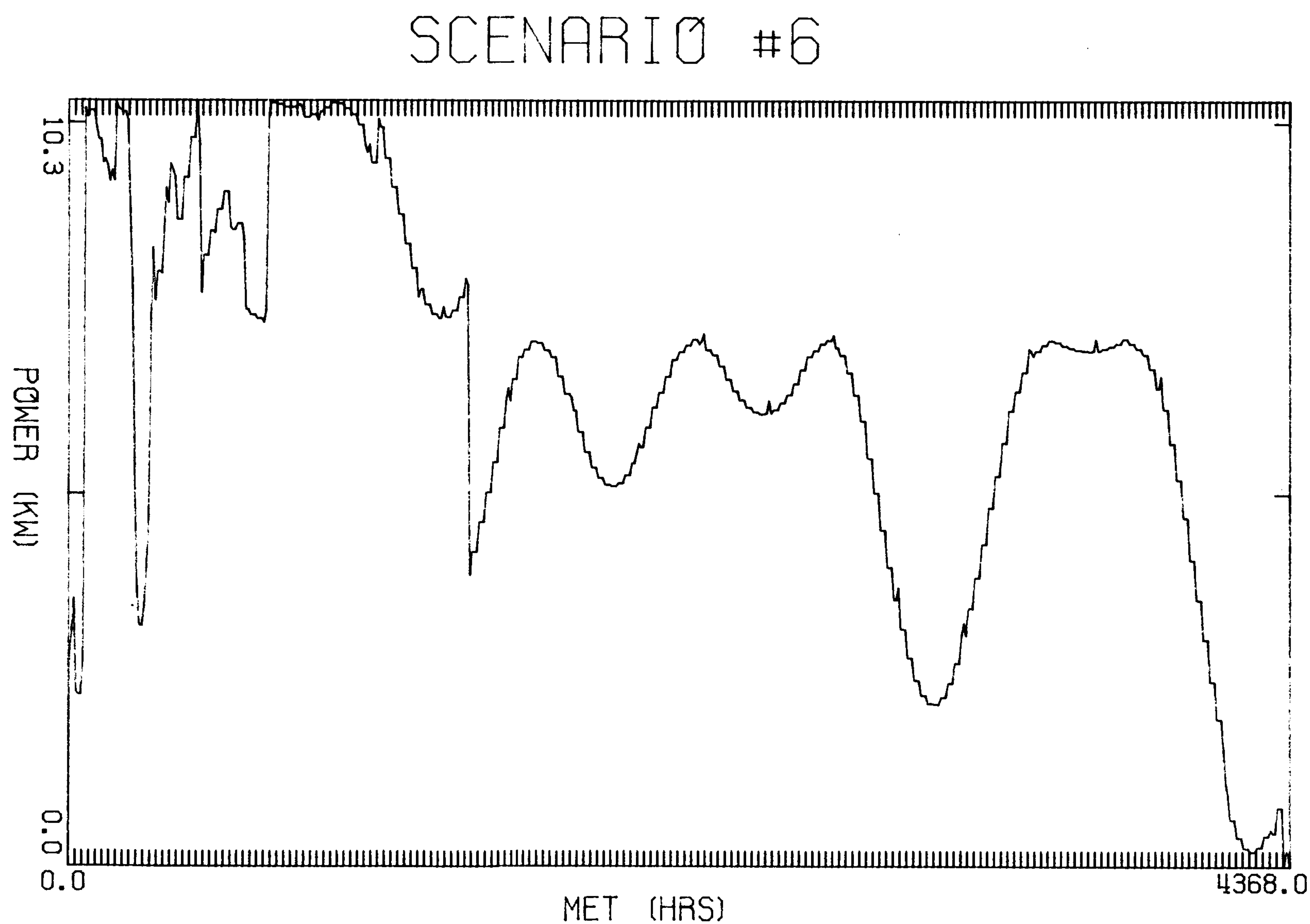
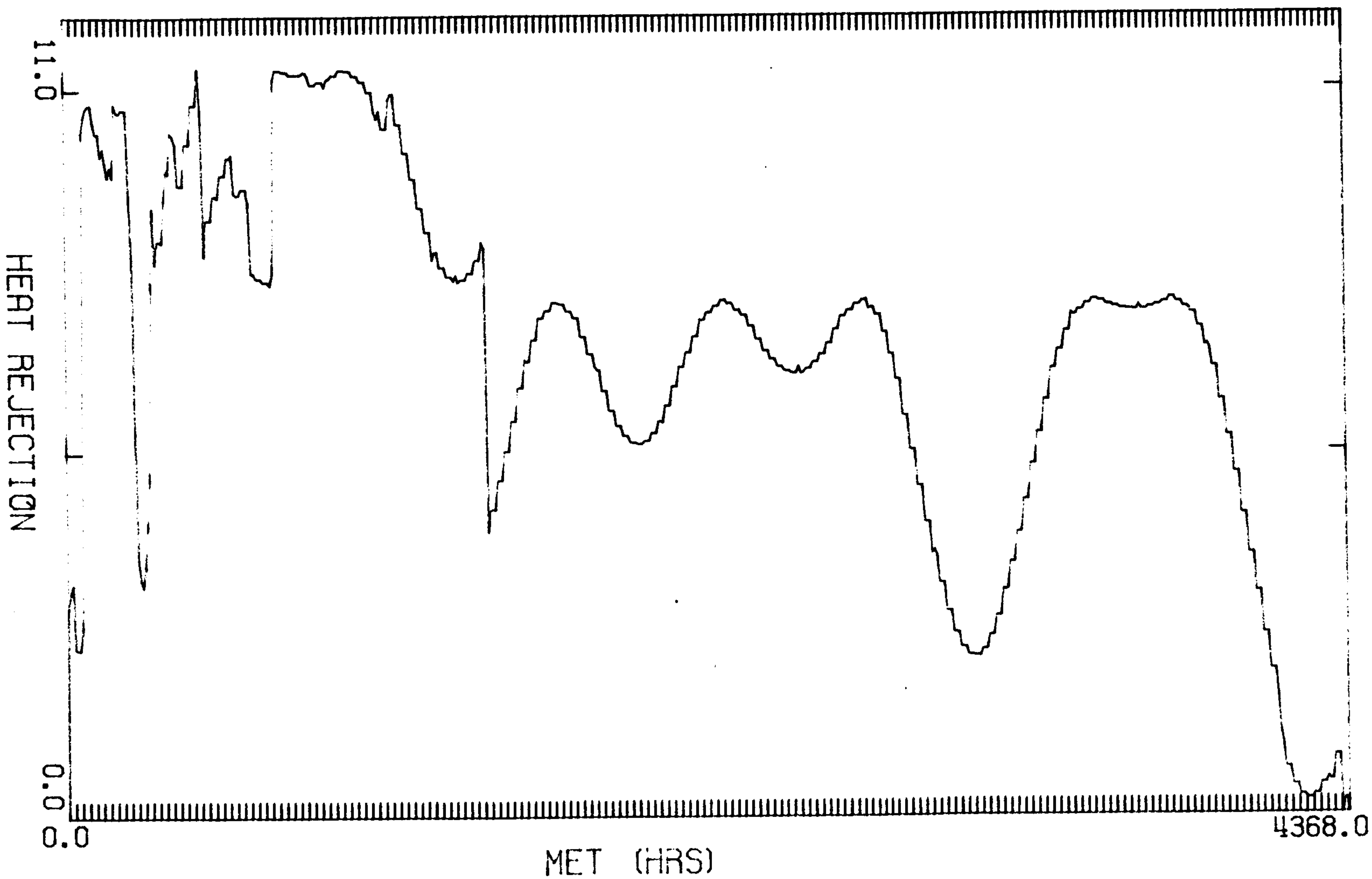


SCENARIØ #5

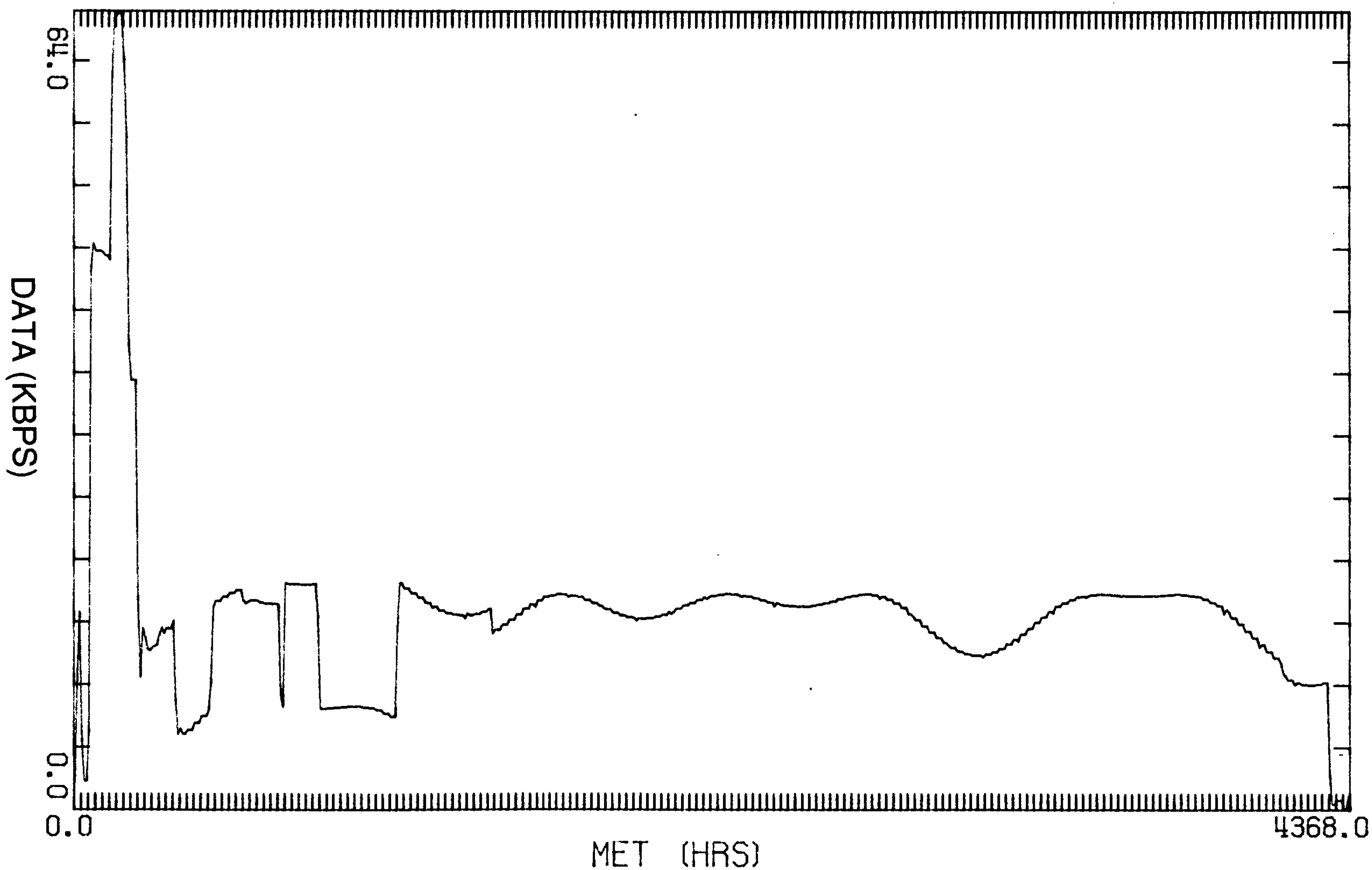


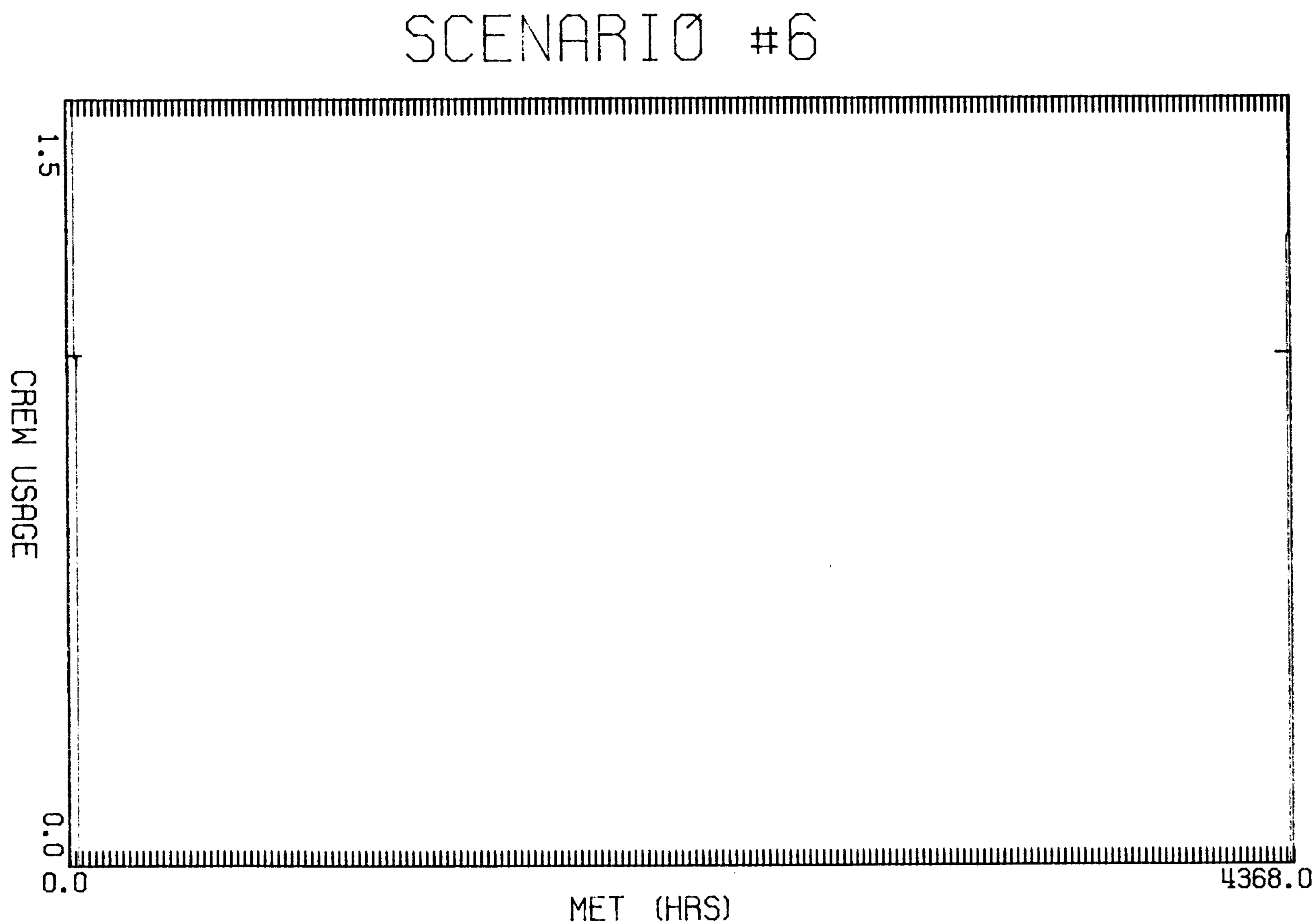

SCENARIØ #6
10.3
0.0
PØWER (KW)
0.0
4368.0
MET (HRS)

SCENARIO #6



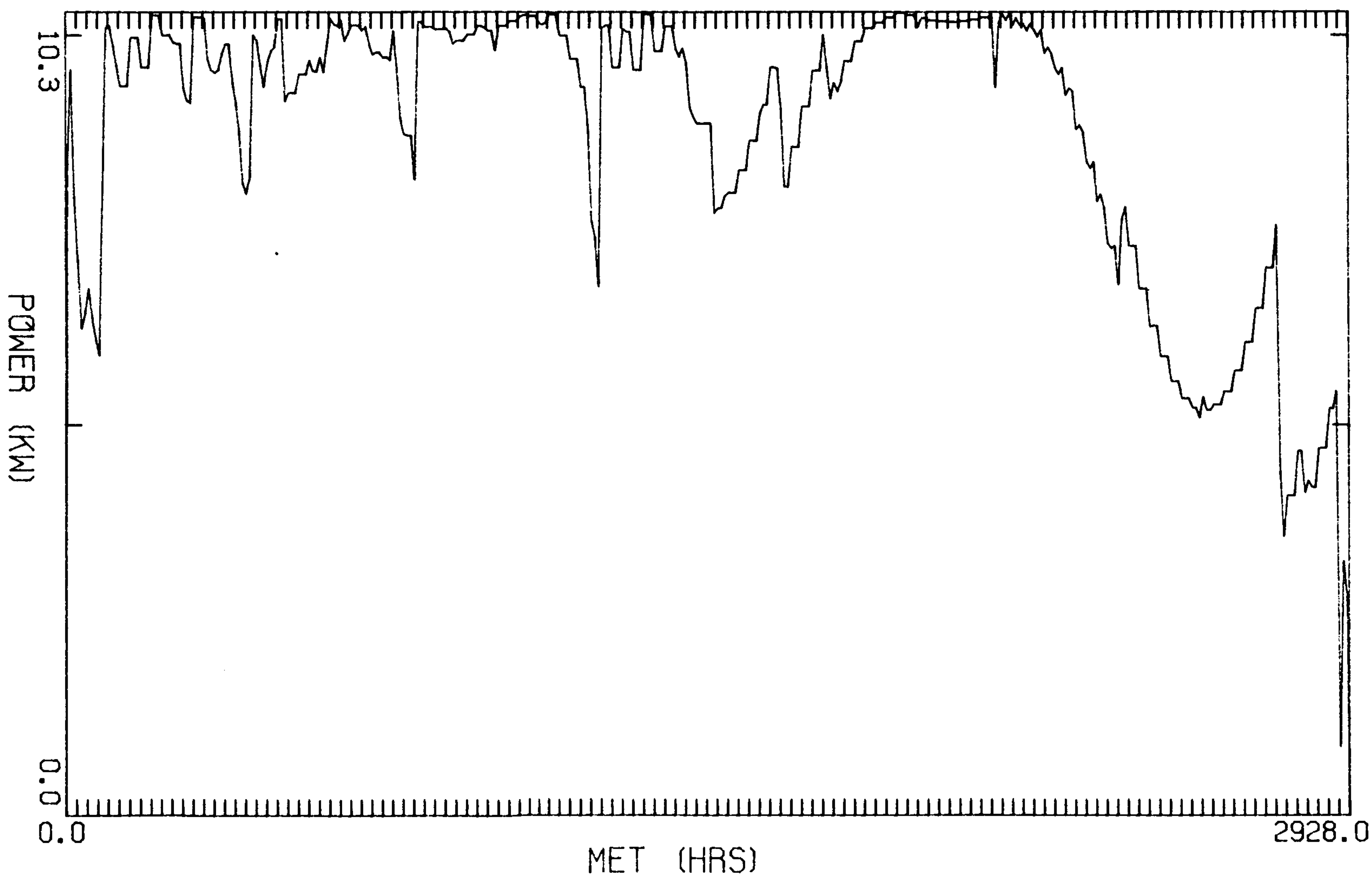
SCENARIO #6



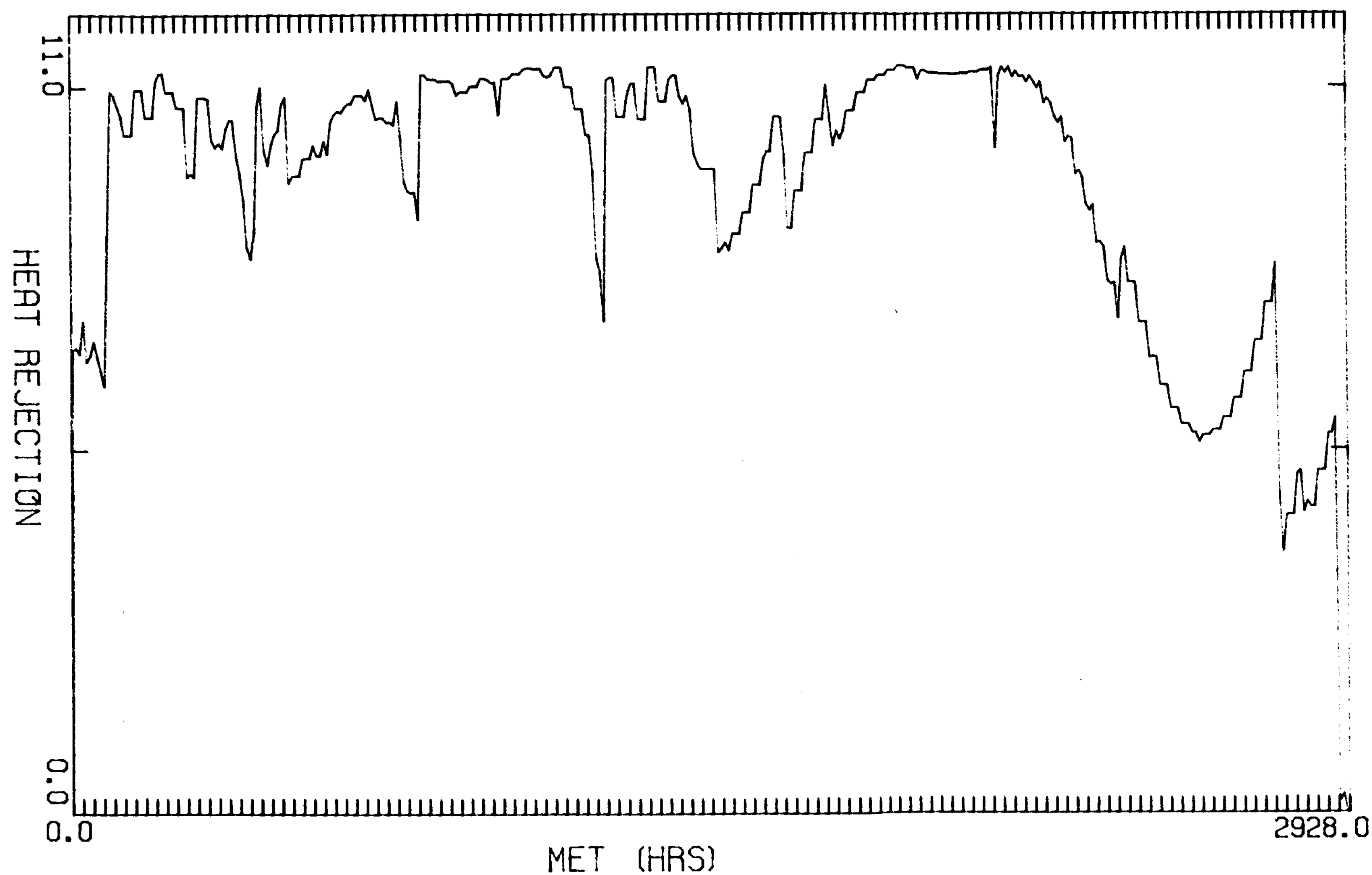


SCENARIØ #6
1.5
CREW USAGE
0.0
0.0
4368.0
MET (HRS)

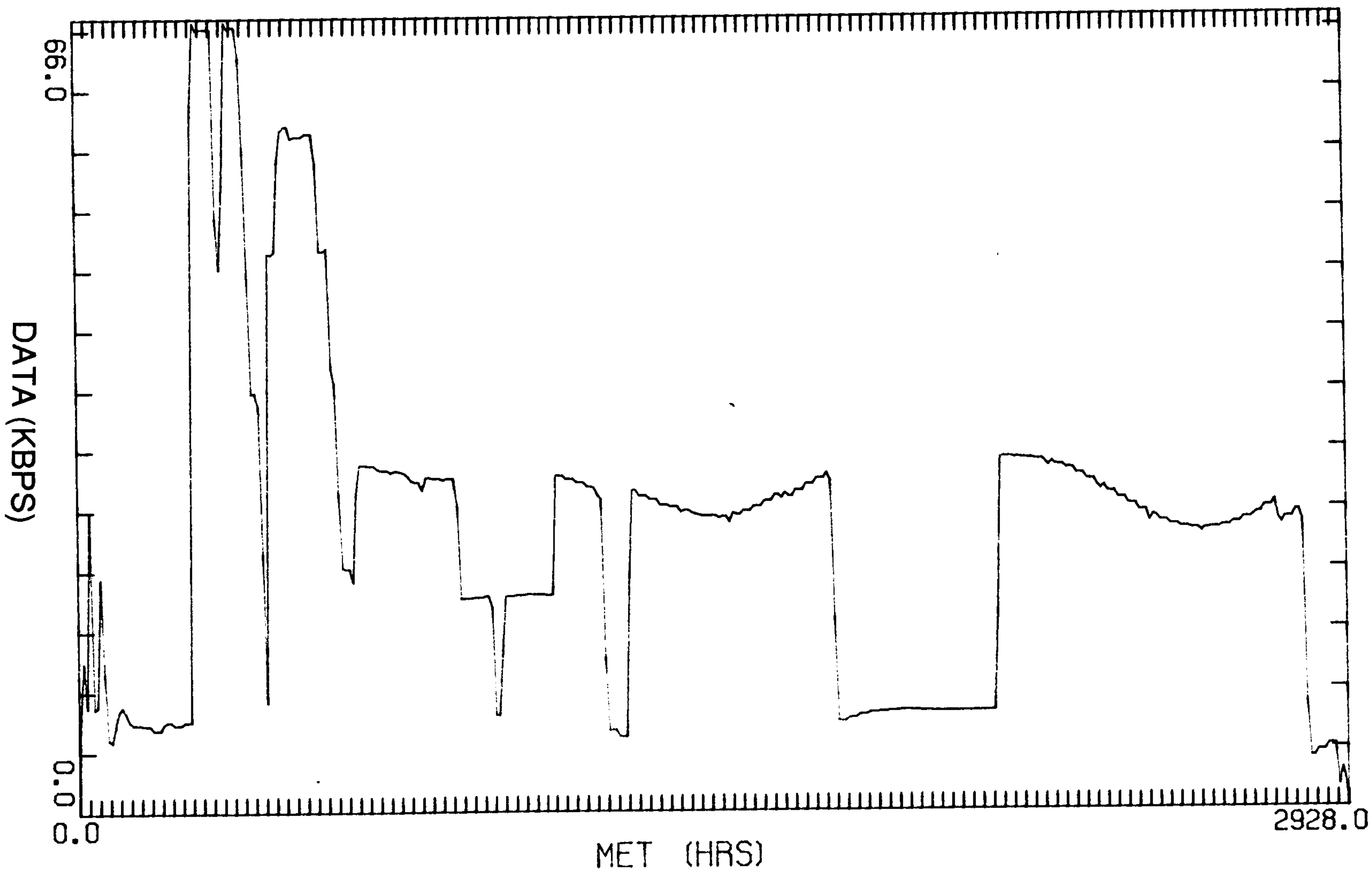
SCENARIØ #7



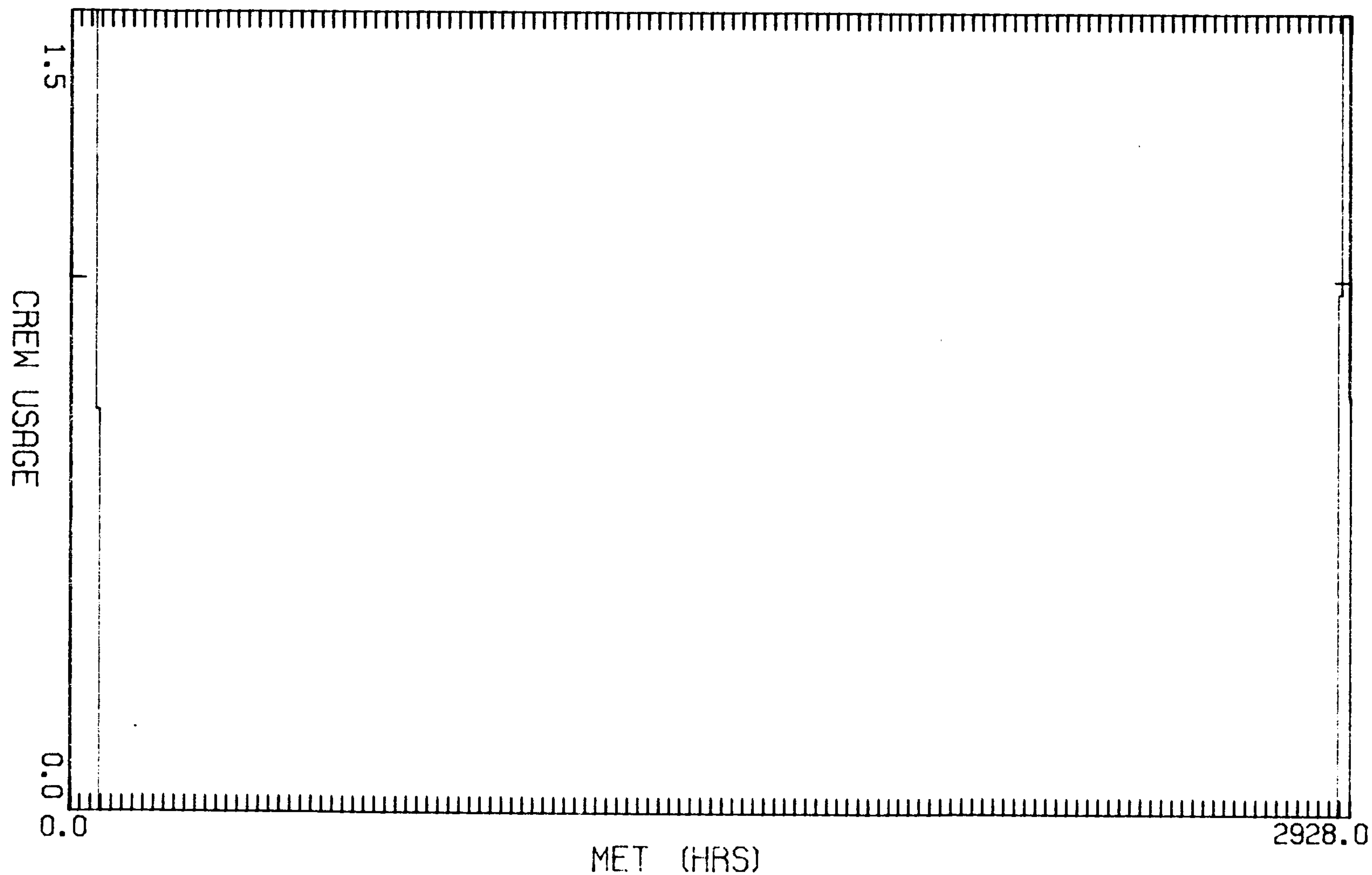
SCENARIØ #7



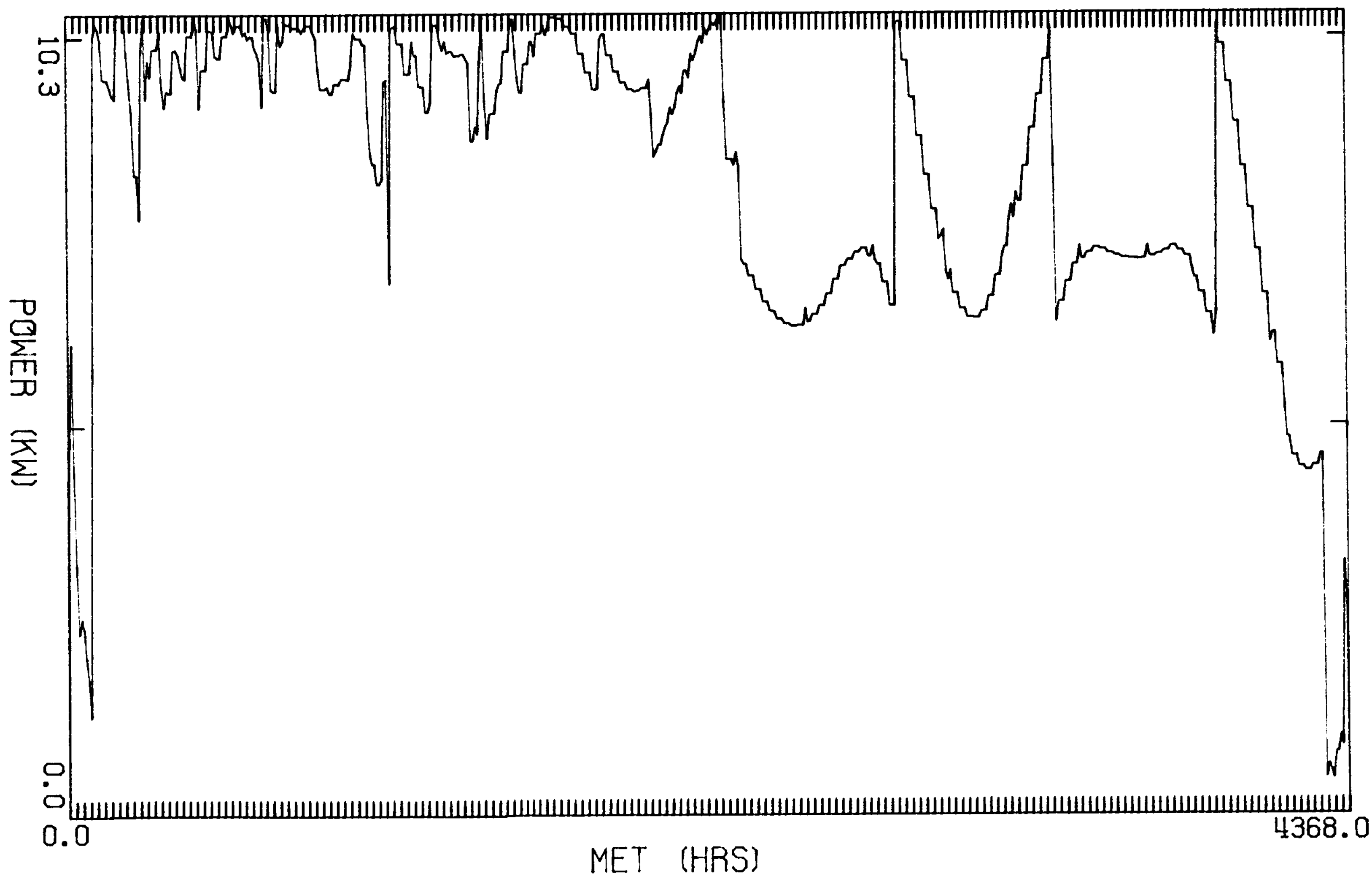
SCENARIO #7



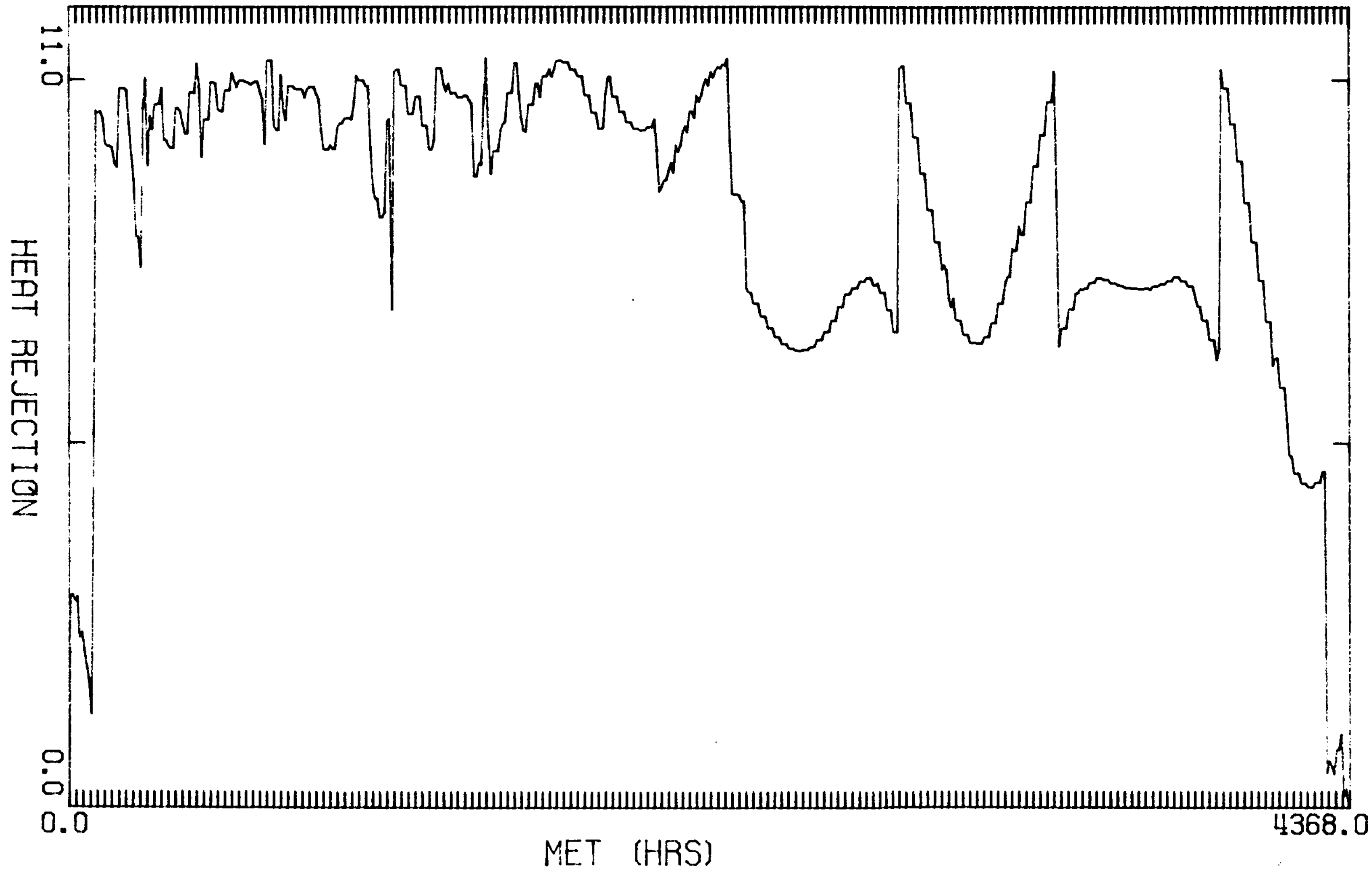
SCENARIØ #7



SCENARIO #8



SCENARIØ #8



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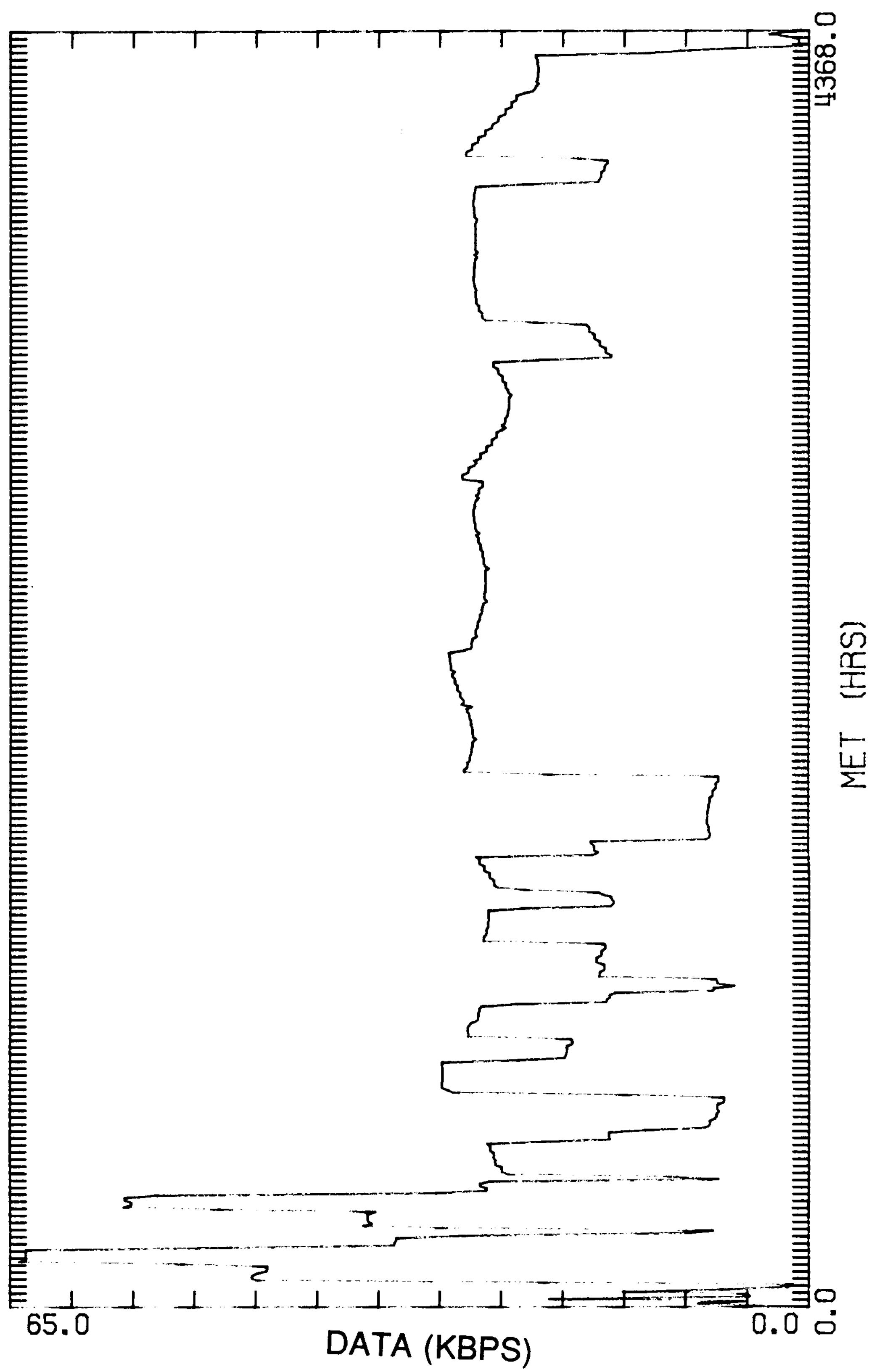
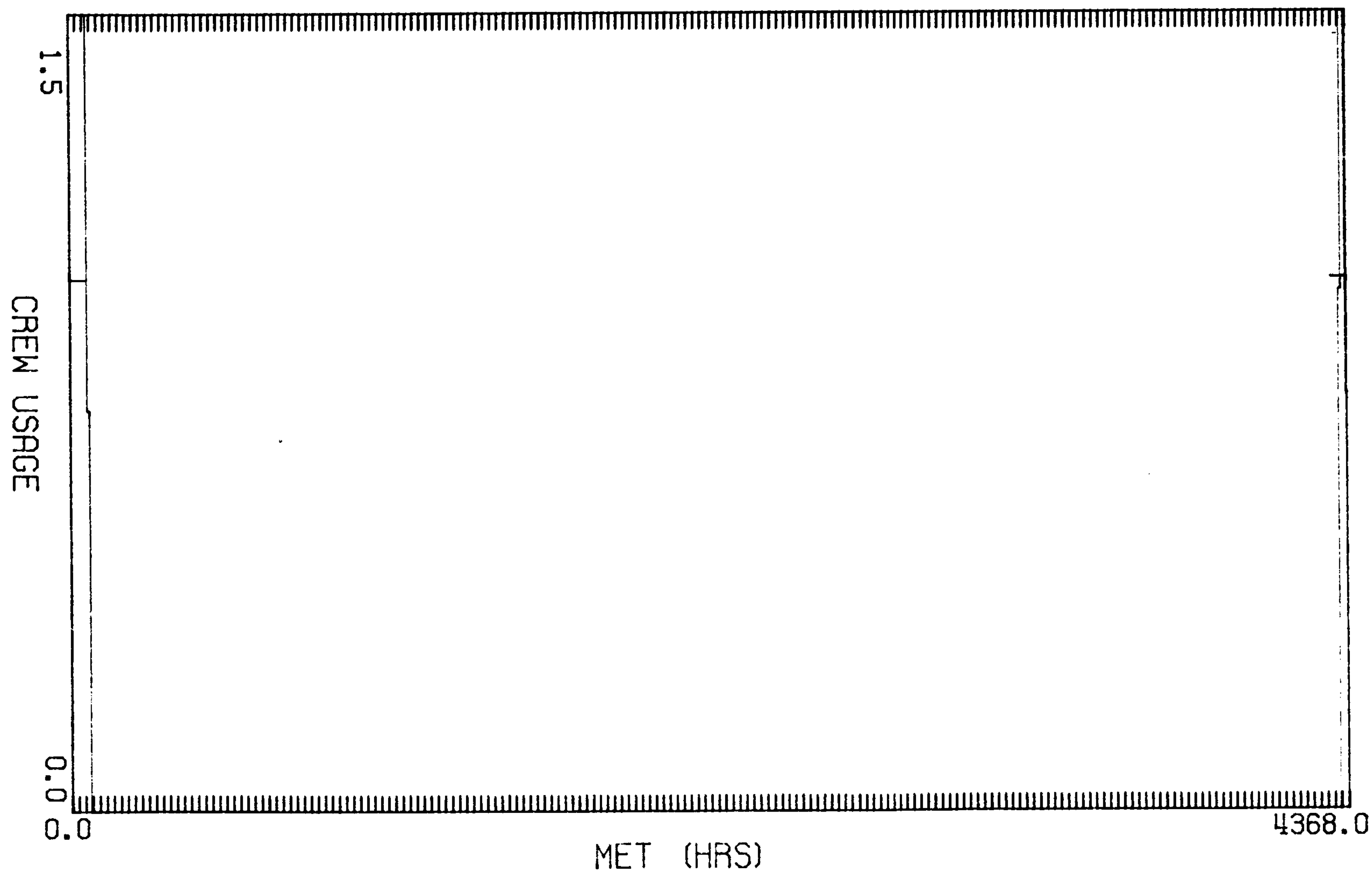
OF POOR QUALITY

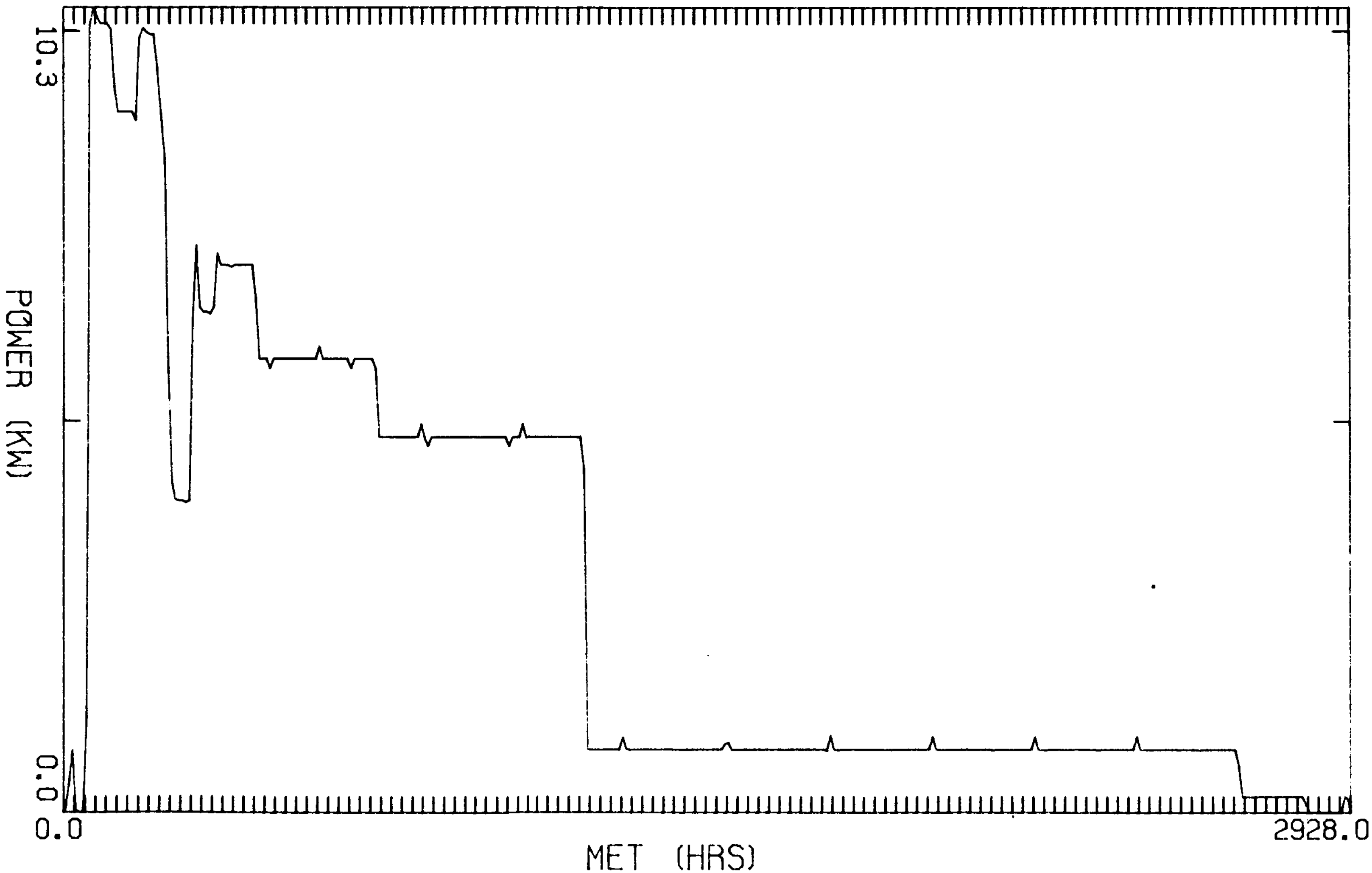
SCENARIO #8



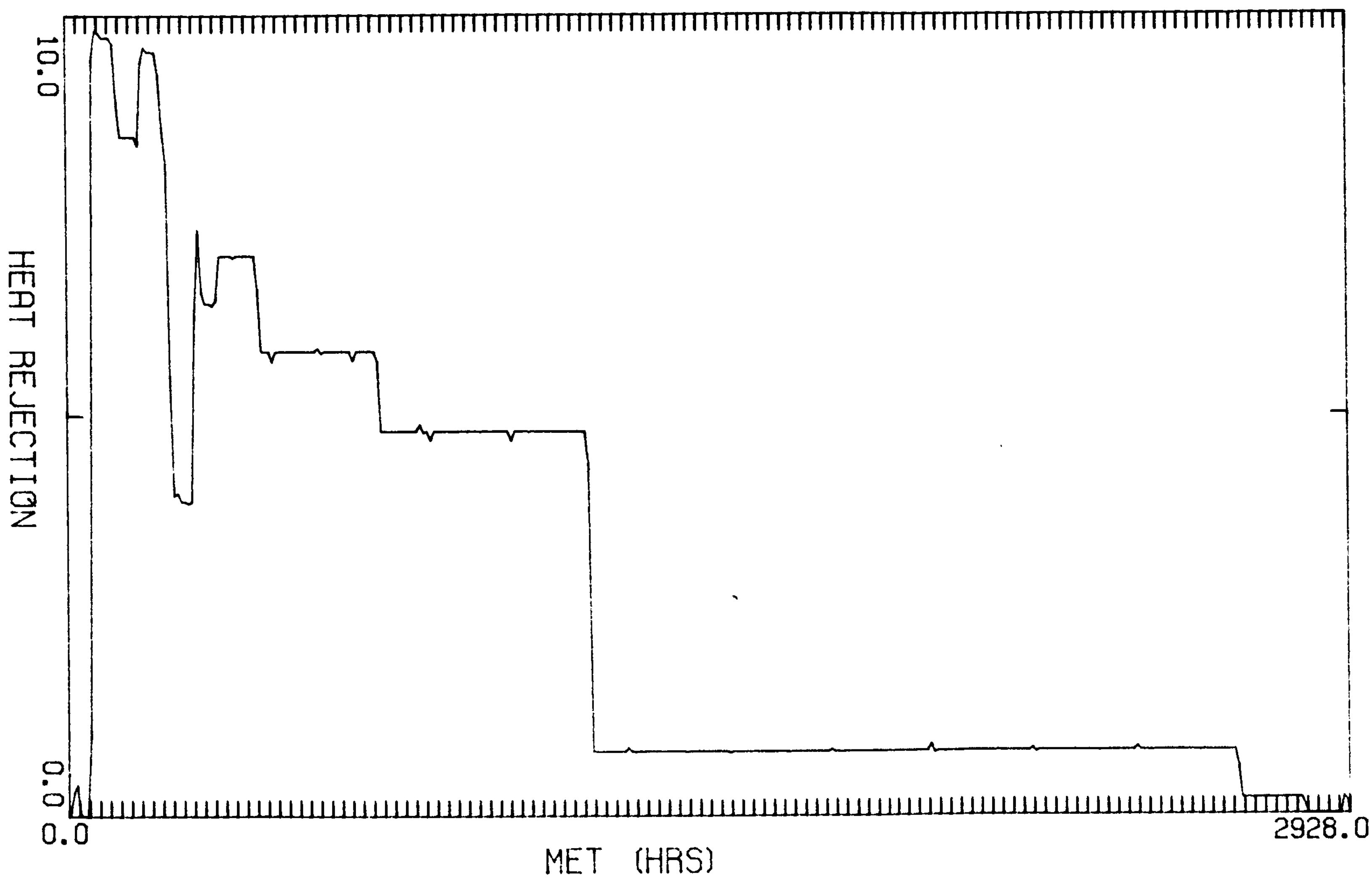
SCENARIO #8



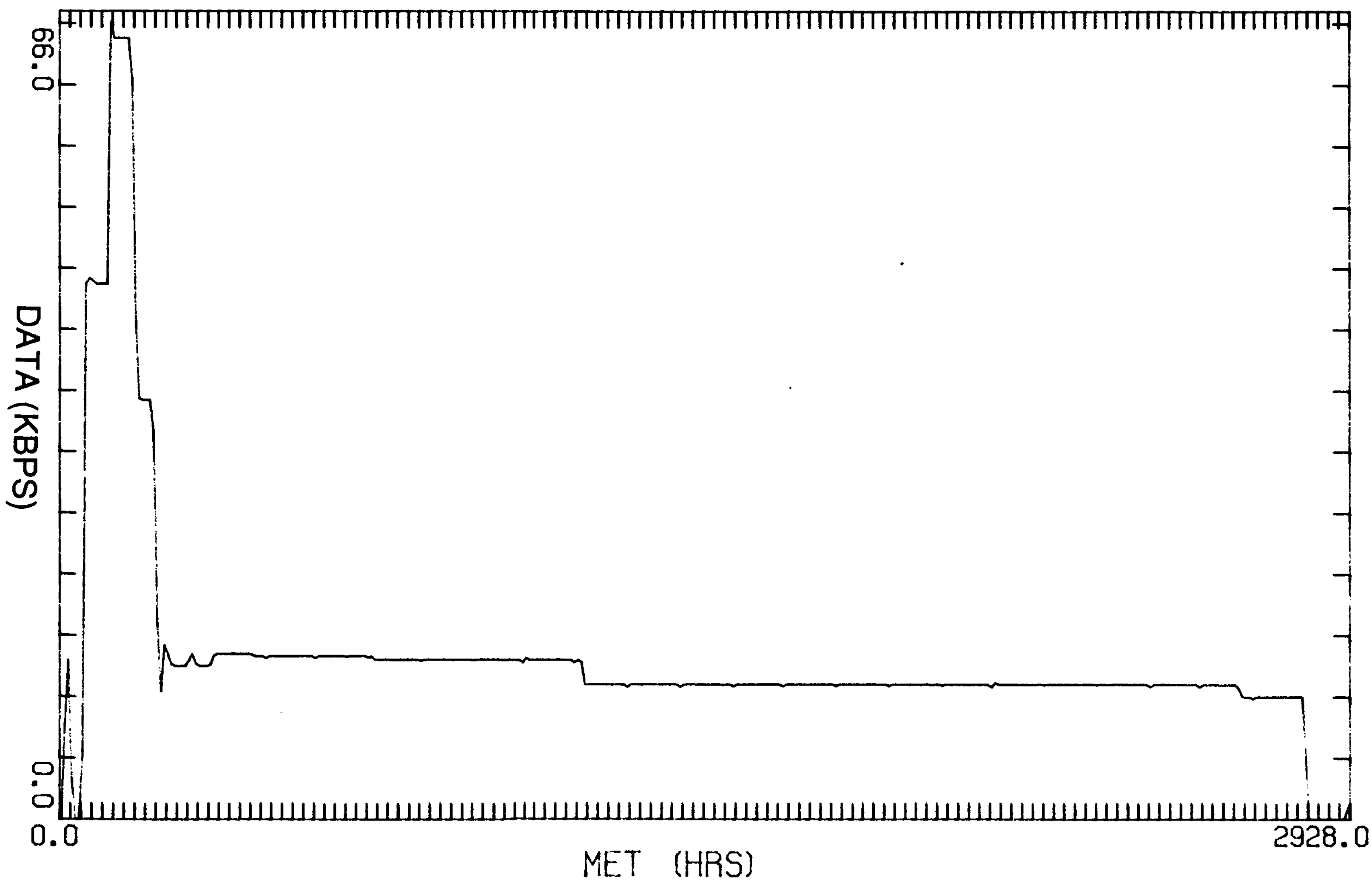
SCENARIØ #9



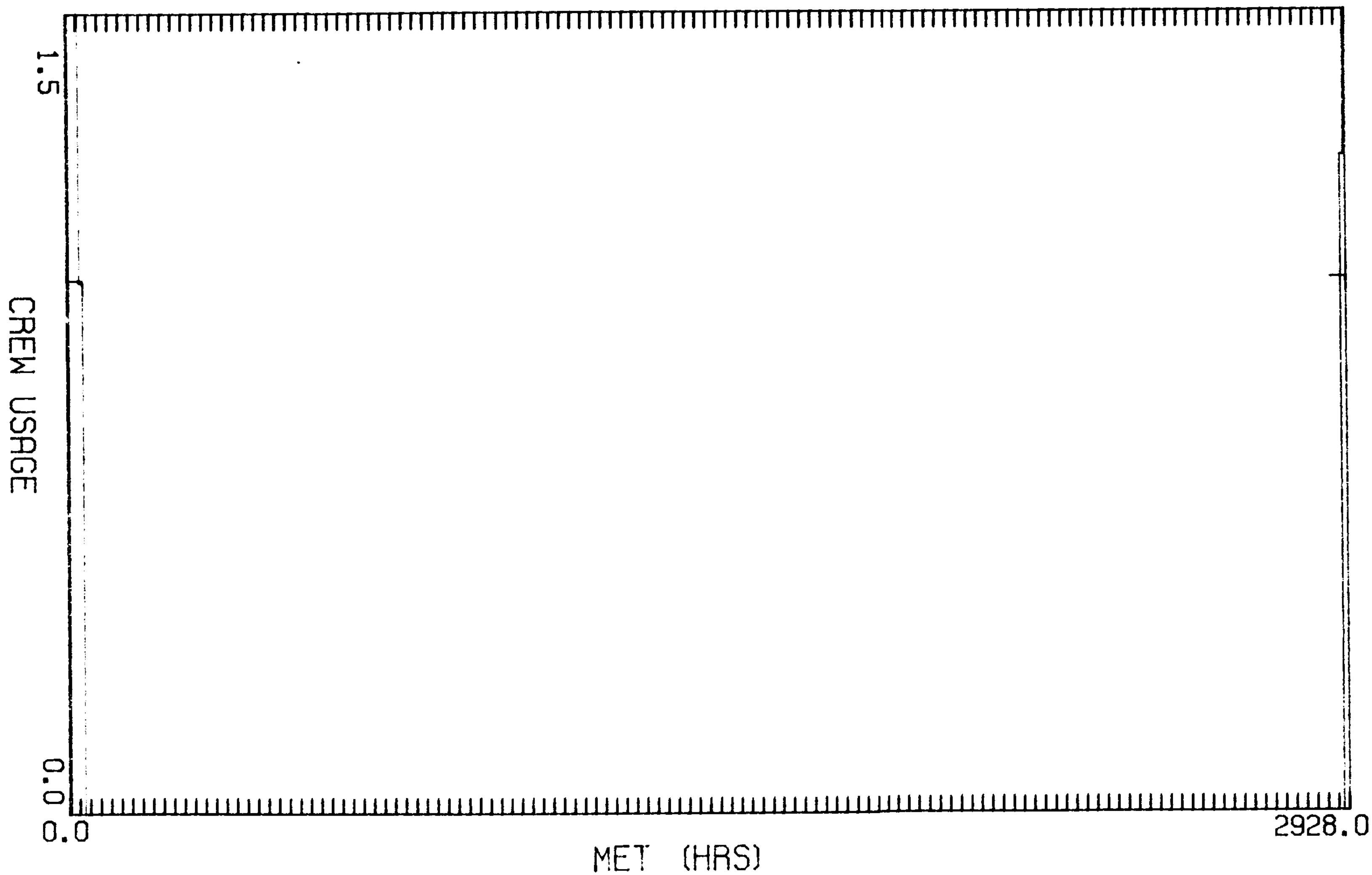
SCENARIØ #9



SCENARIO #9



SCENARIØ #9



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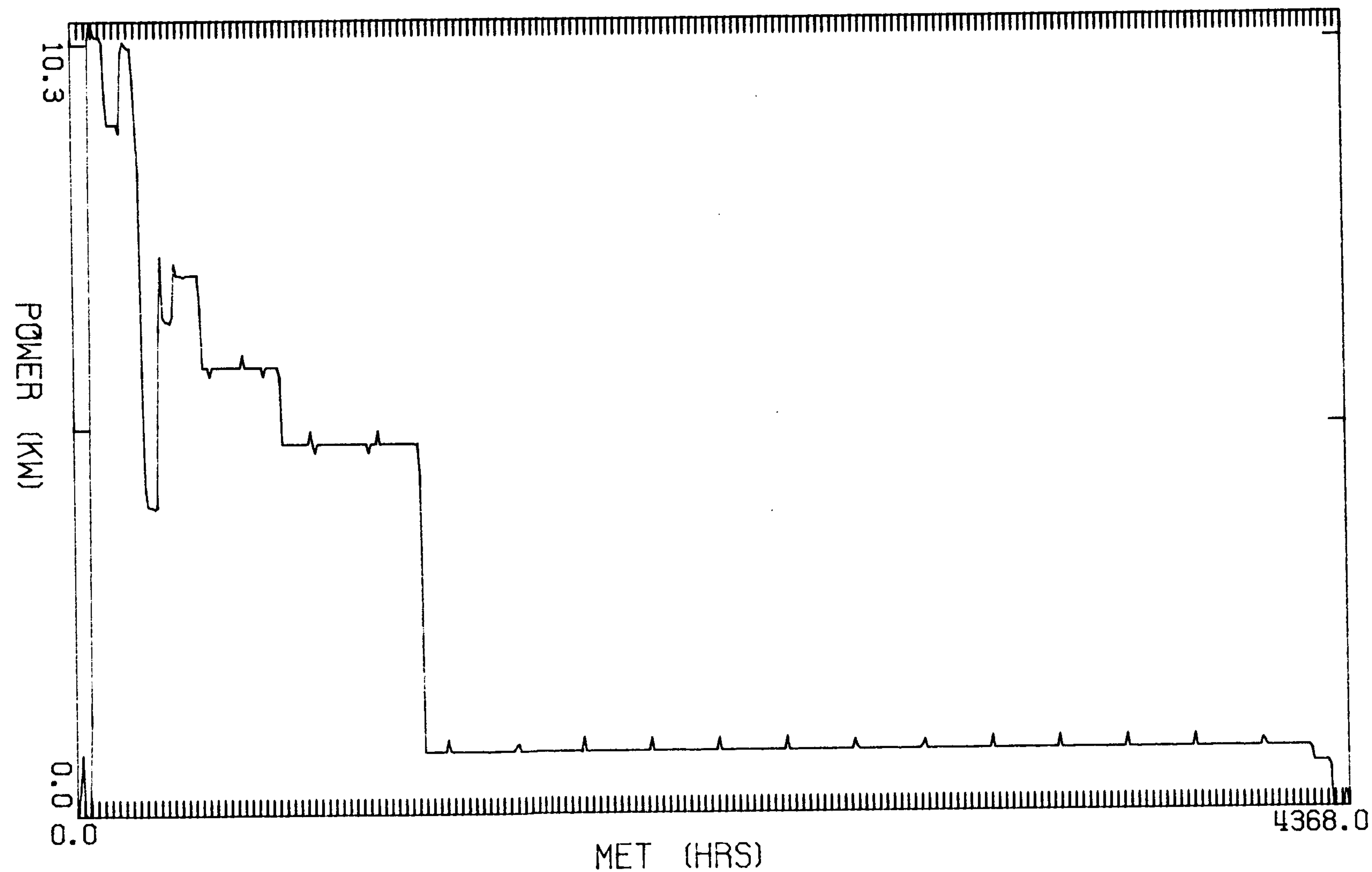
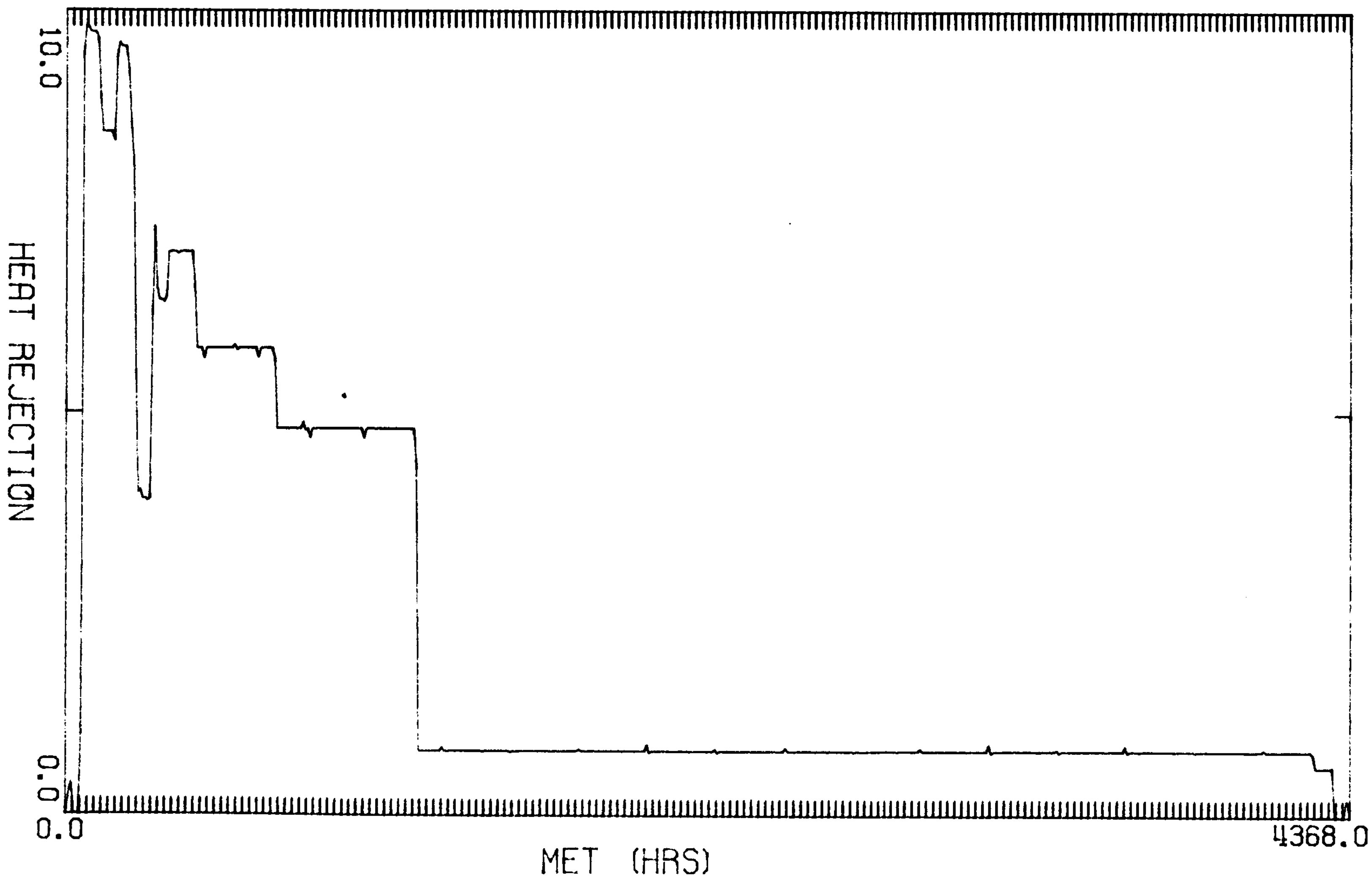
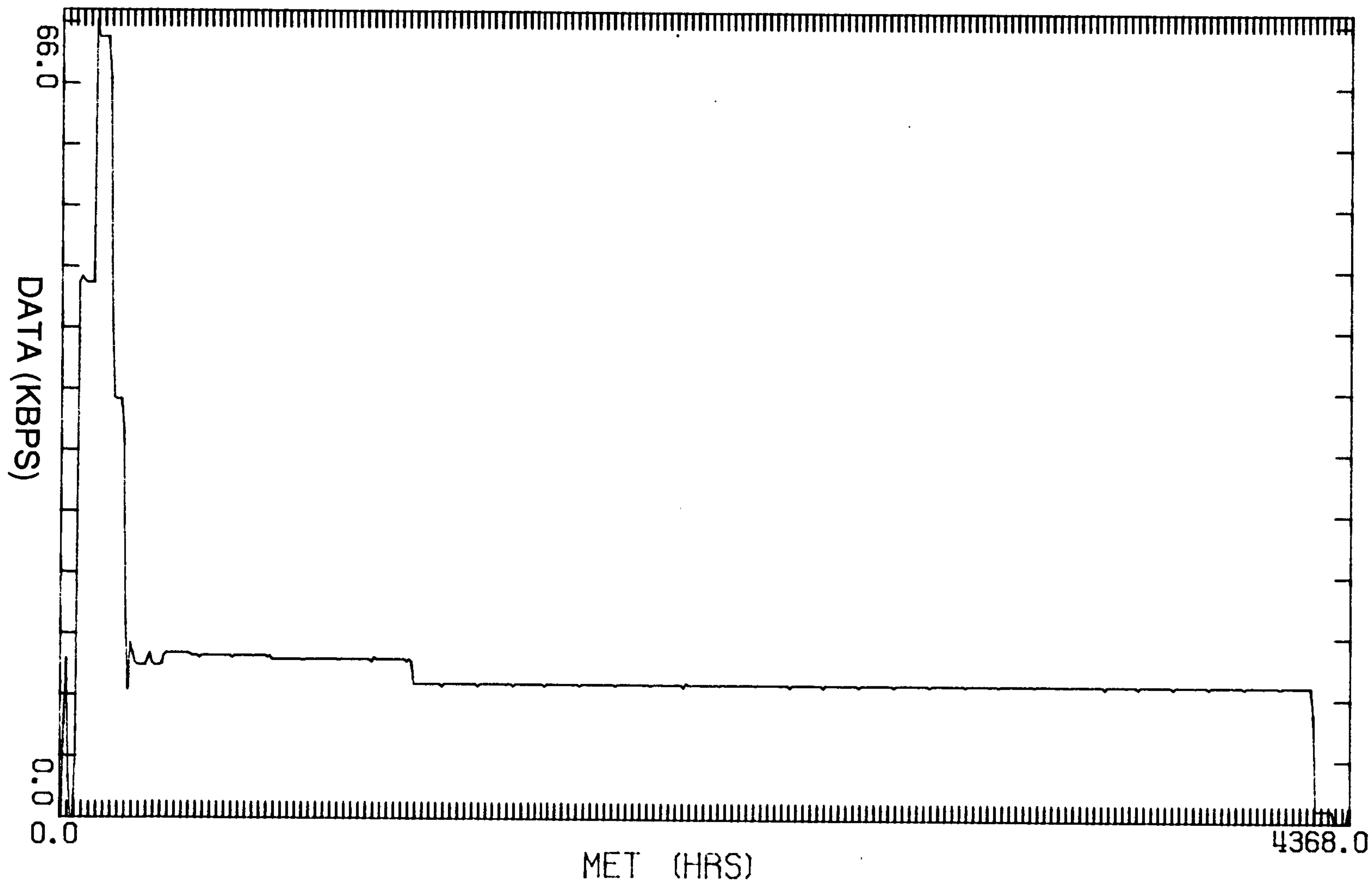
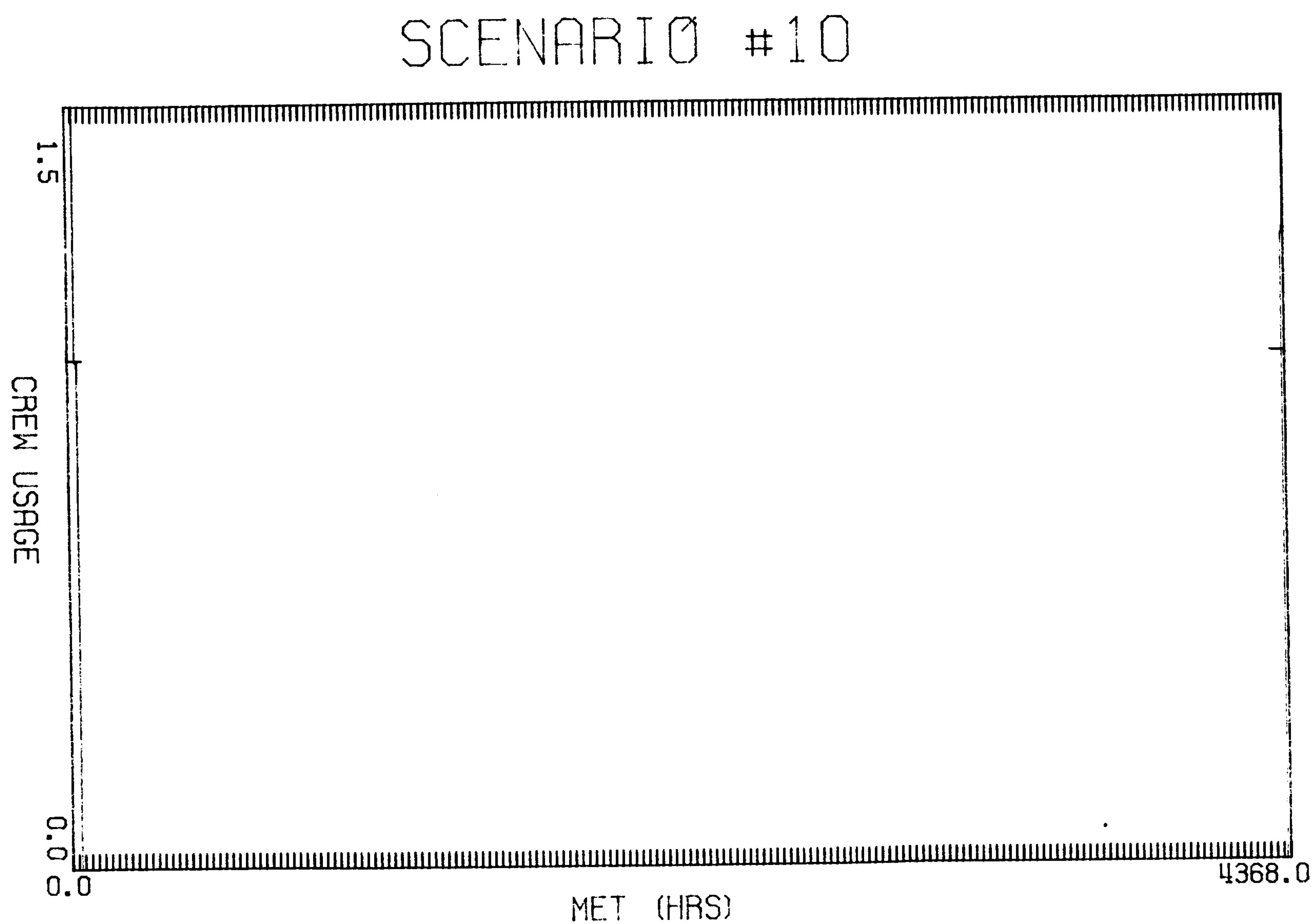


SCENARIØ #10

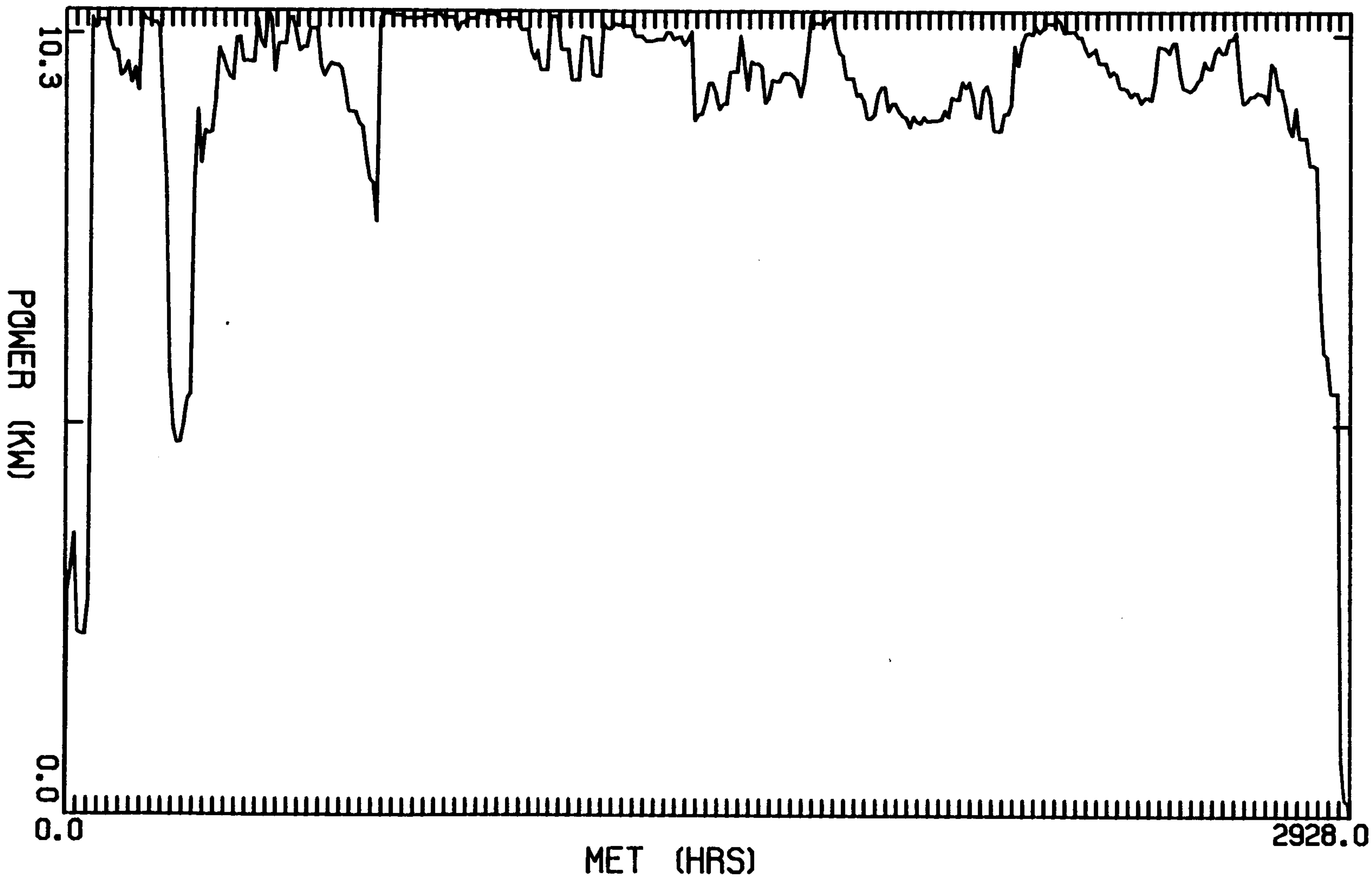


SCENARIØ #10

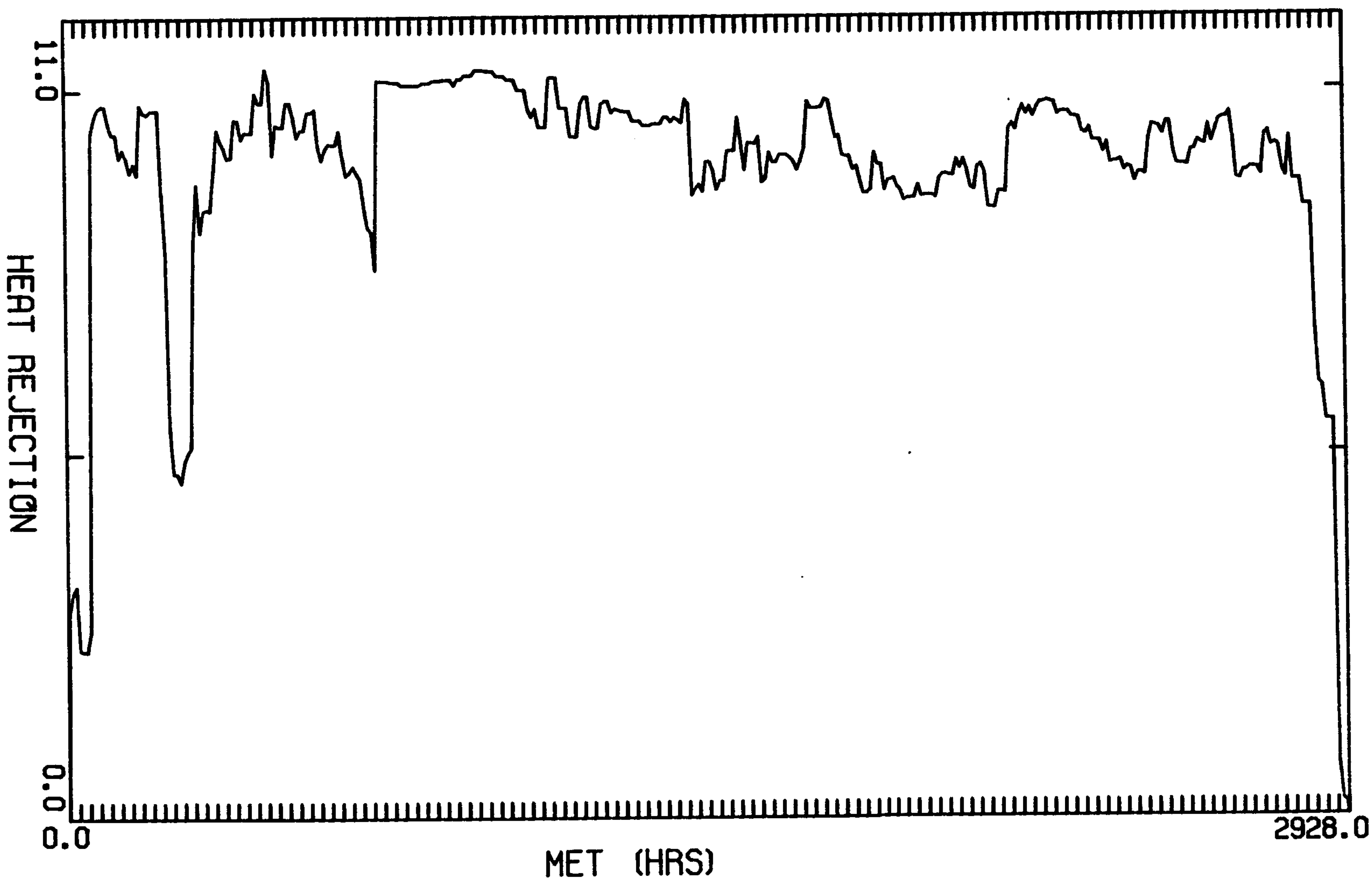



SCENARIØ #10
1.5
0.0
CREW USAGE
0.0
4368.0
MET (HRS)

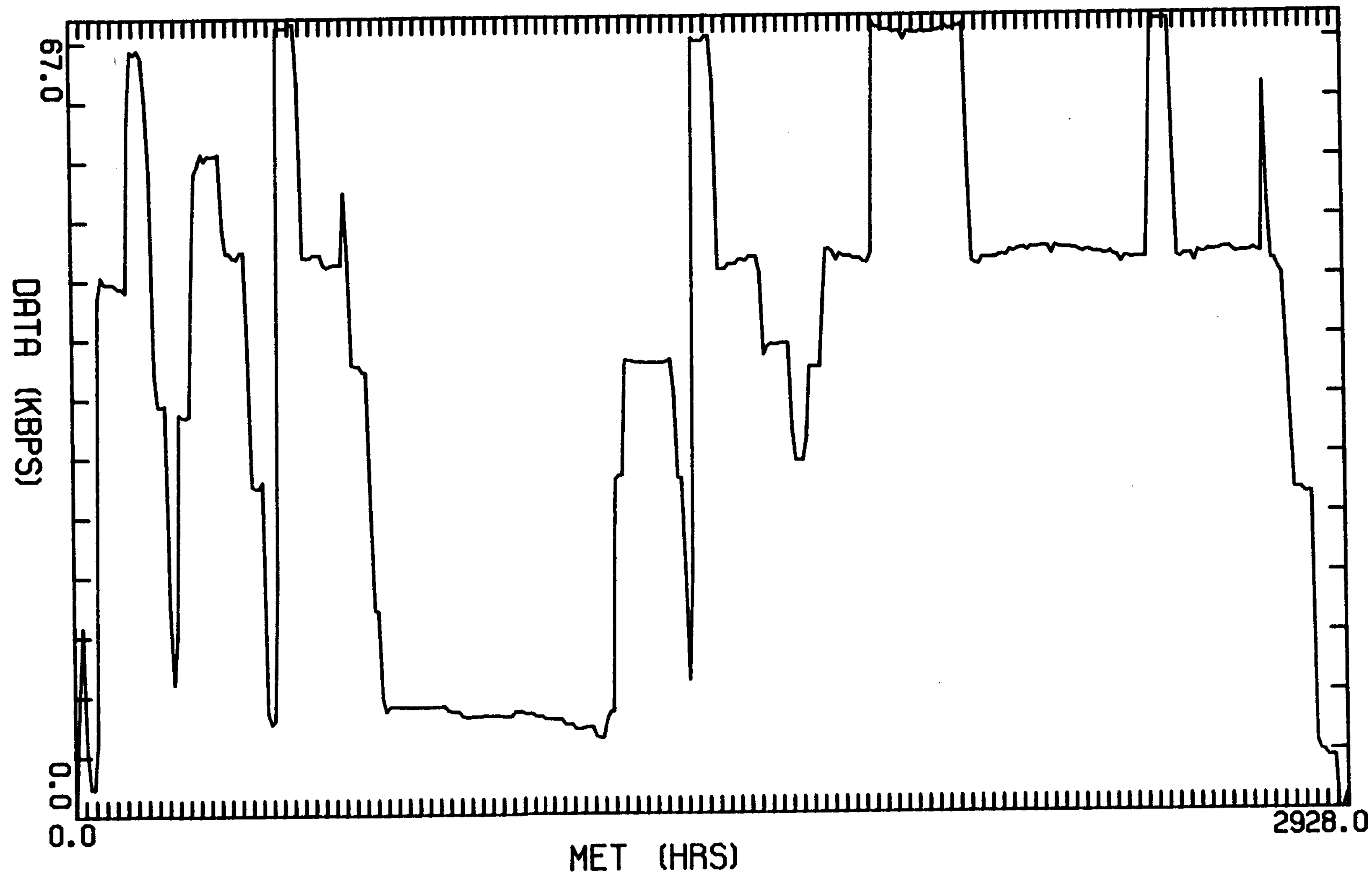
SCENARIO #11



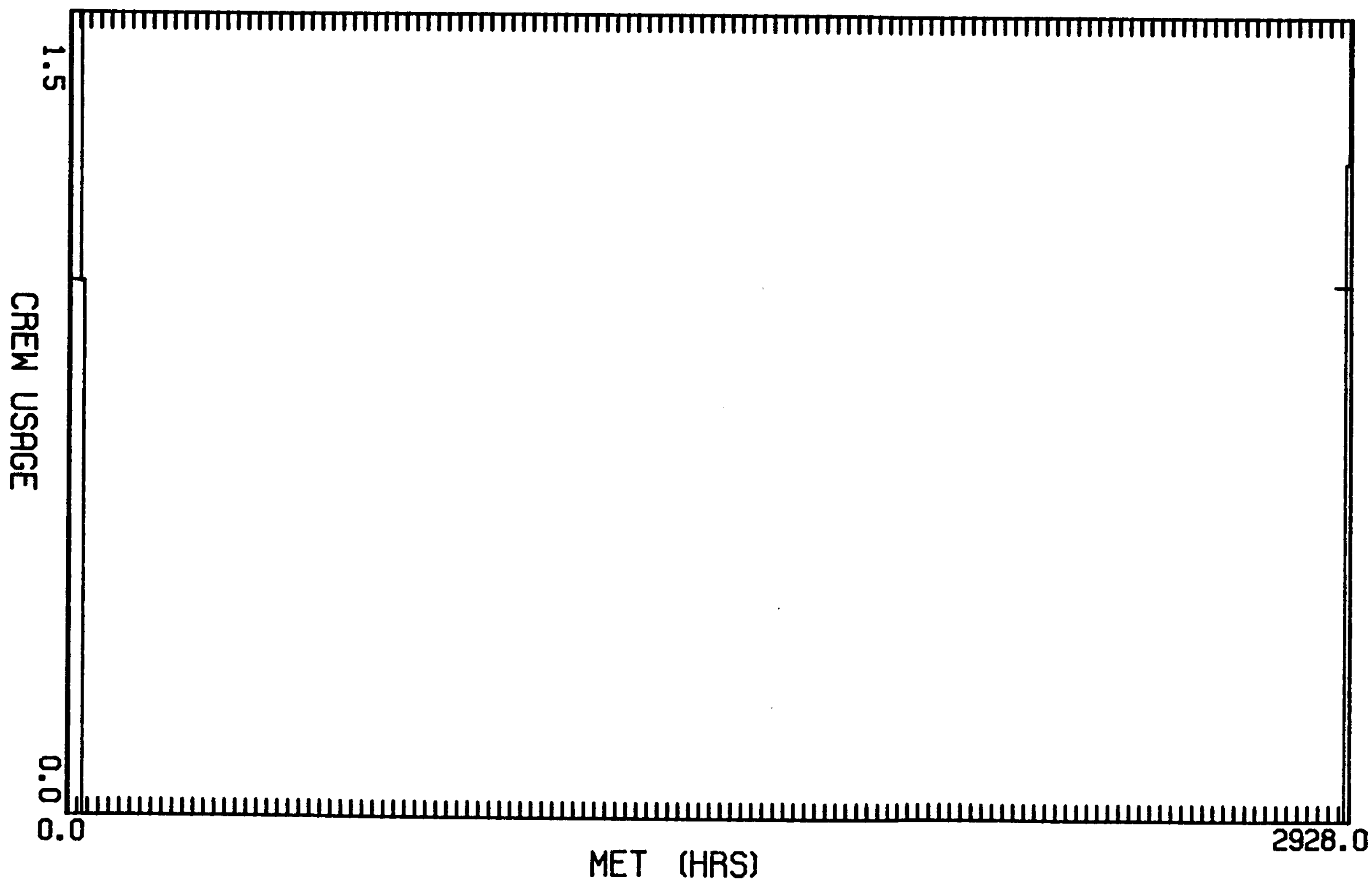
SCENARIØ #11



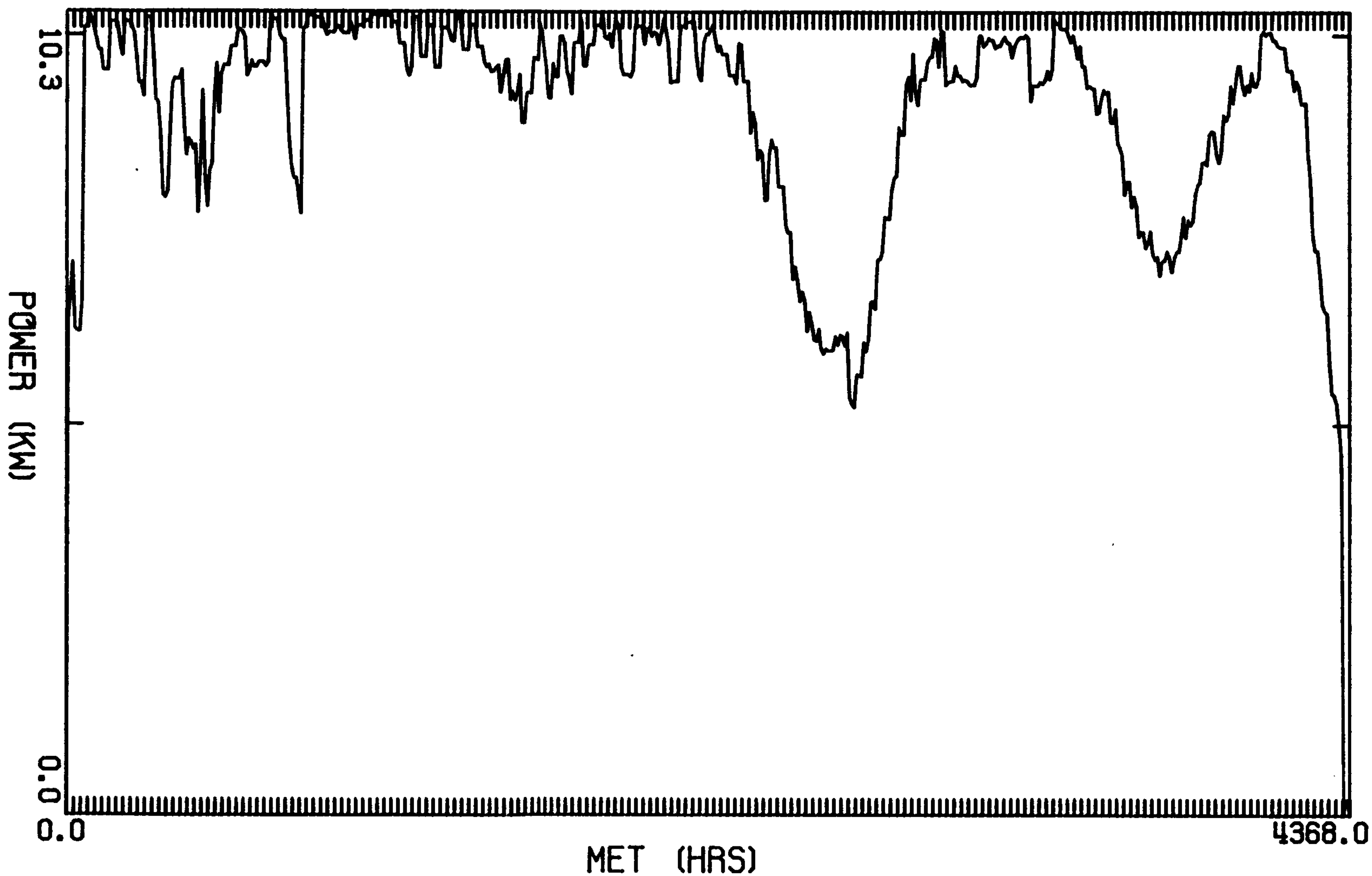
SCENARIØ #11



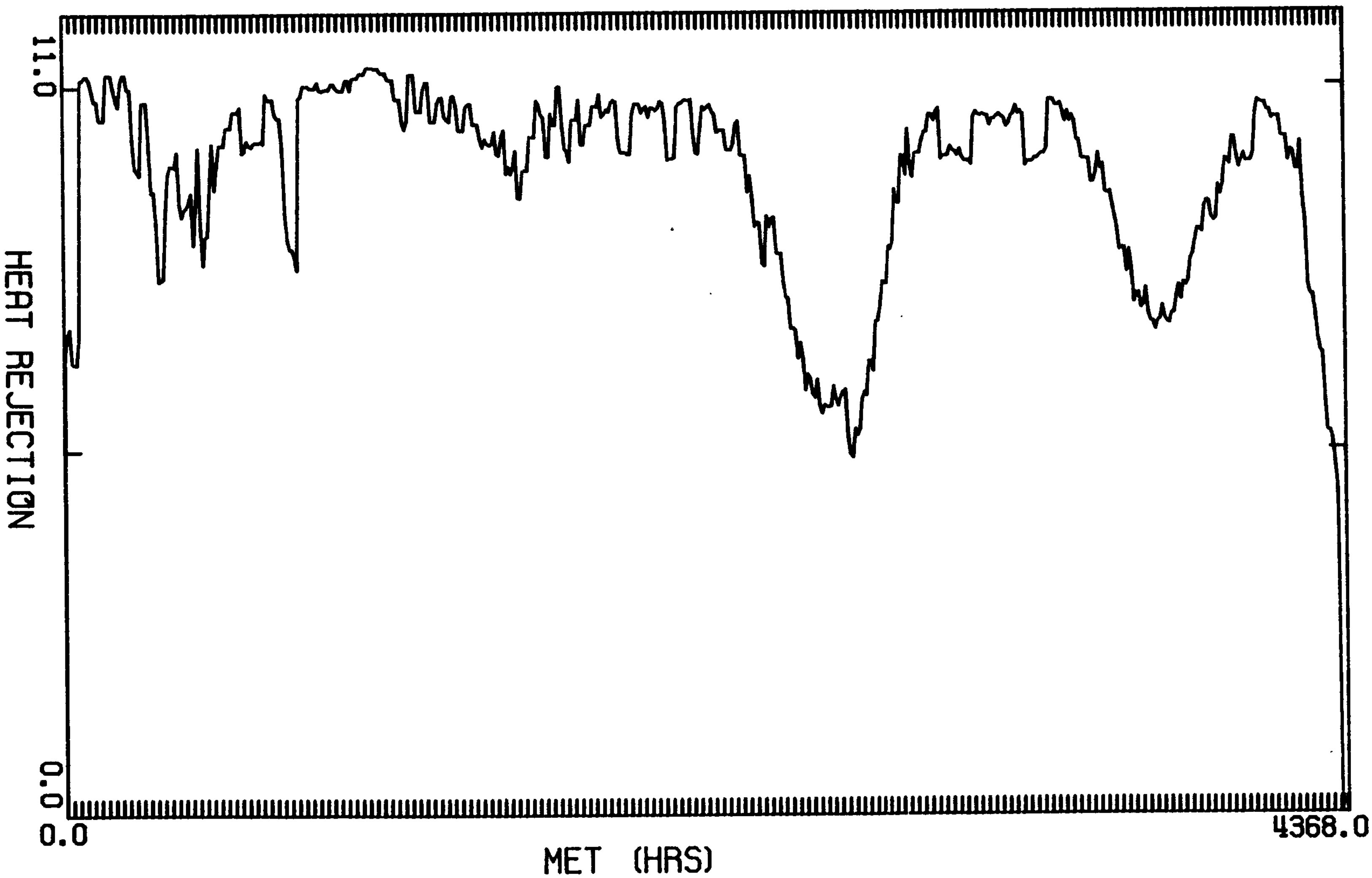
SCENARIO #11



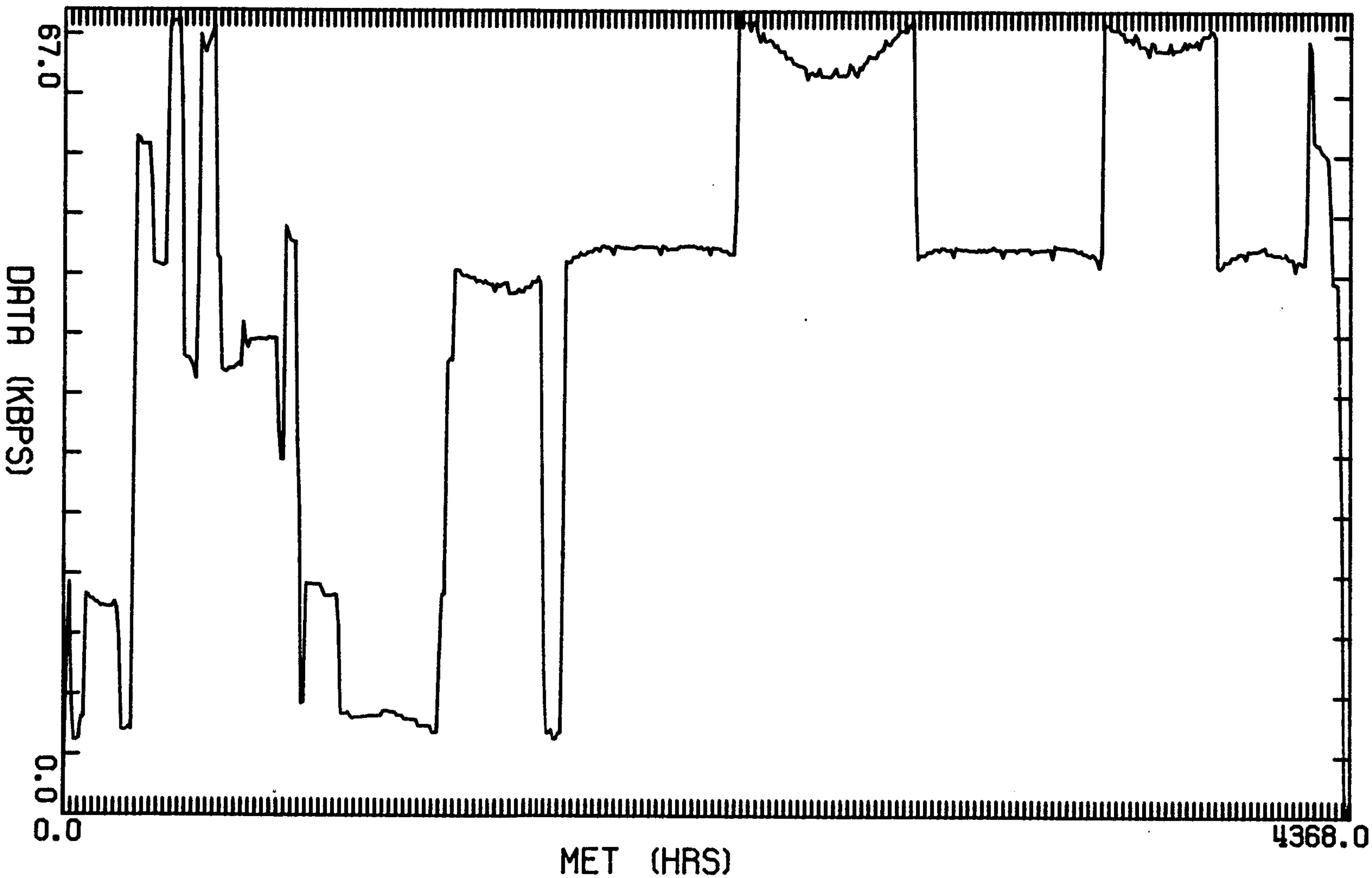
SCENARIØ #12

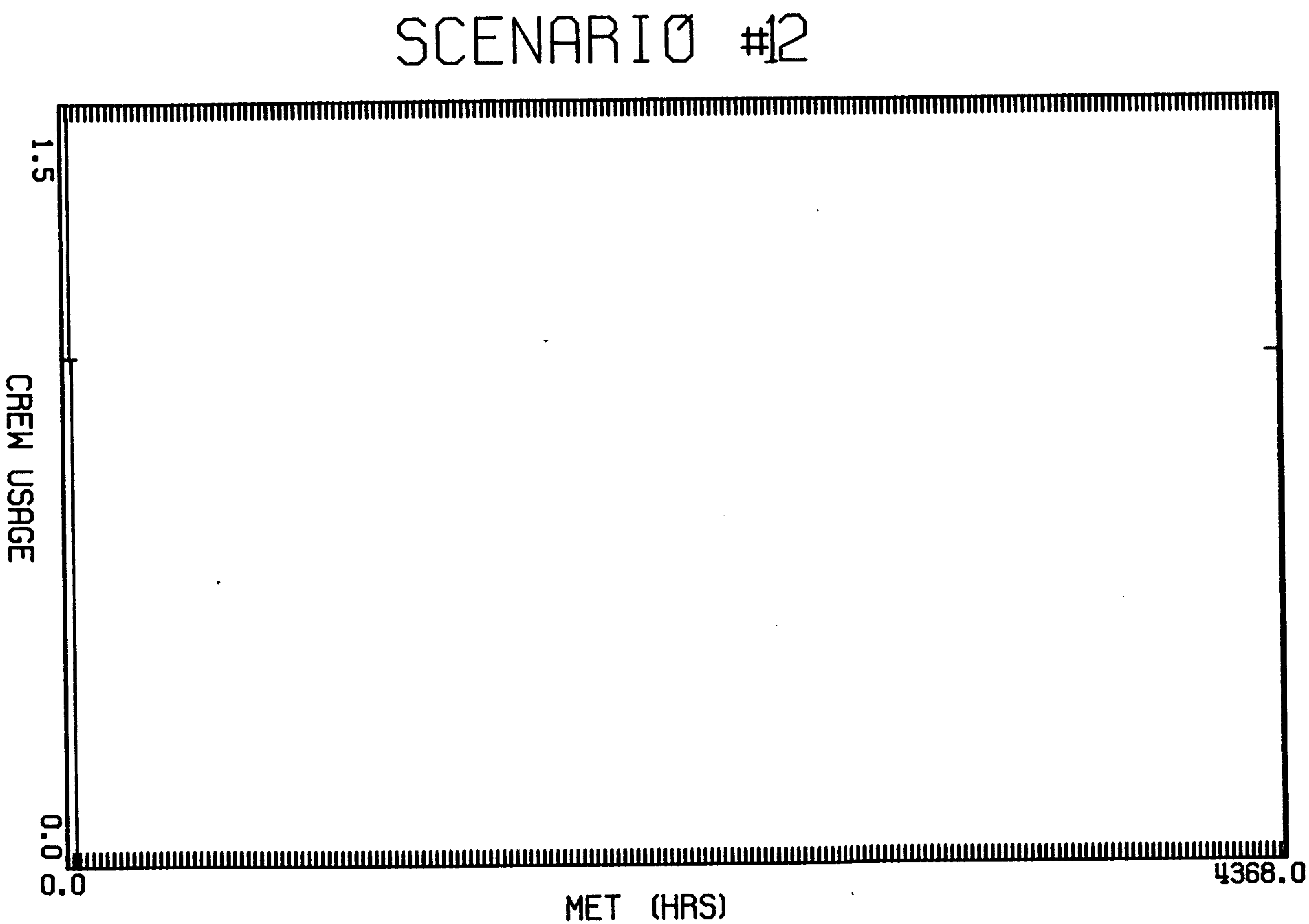


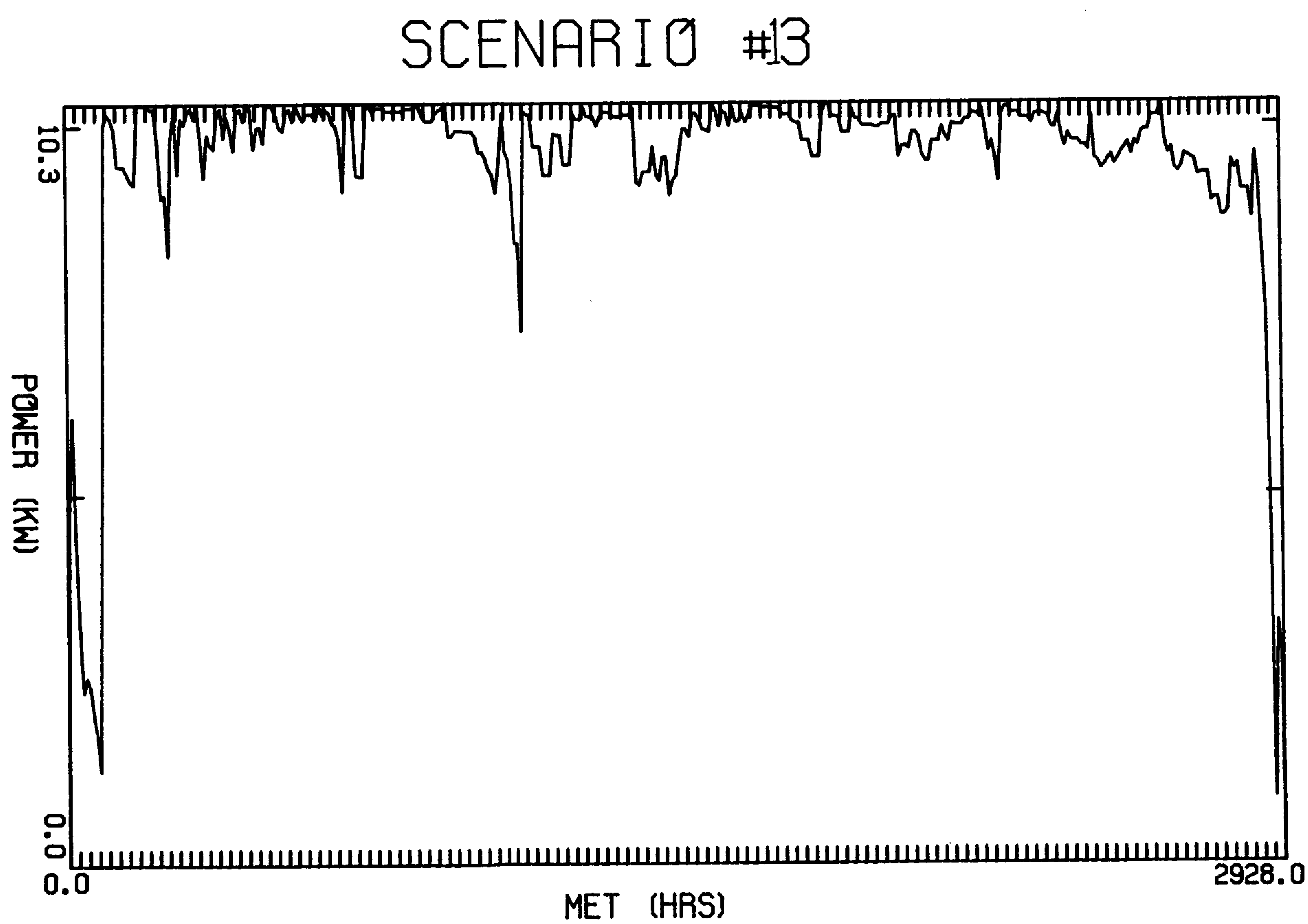
SCENARIO #12



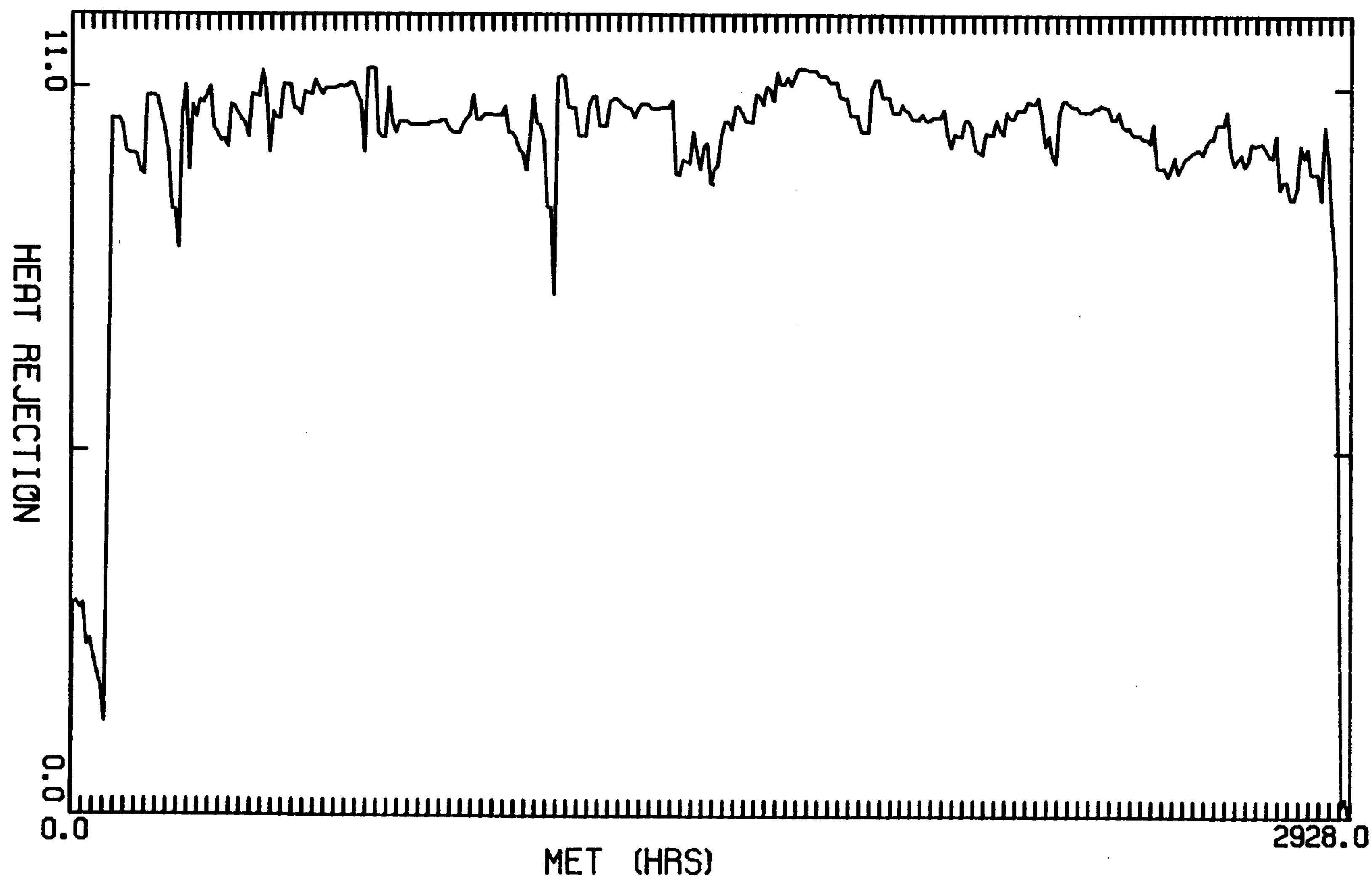
SCENARIO #12



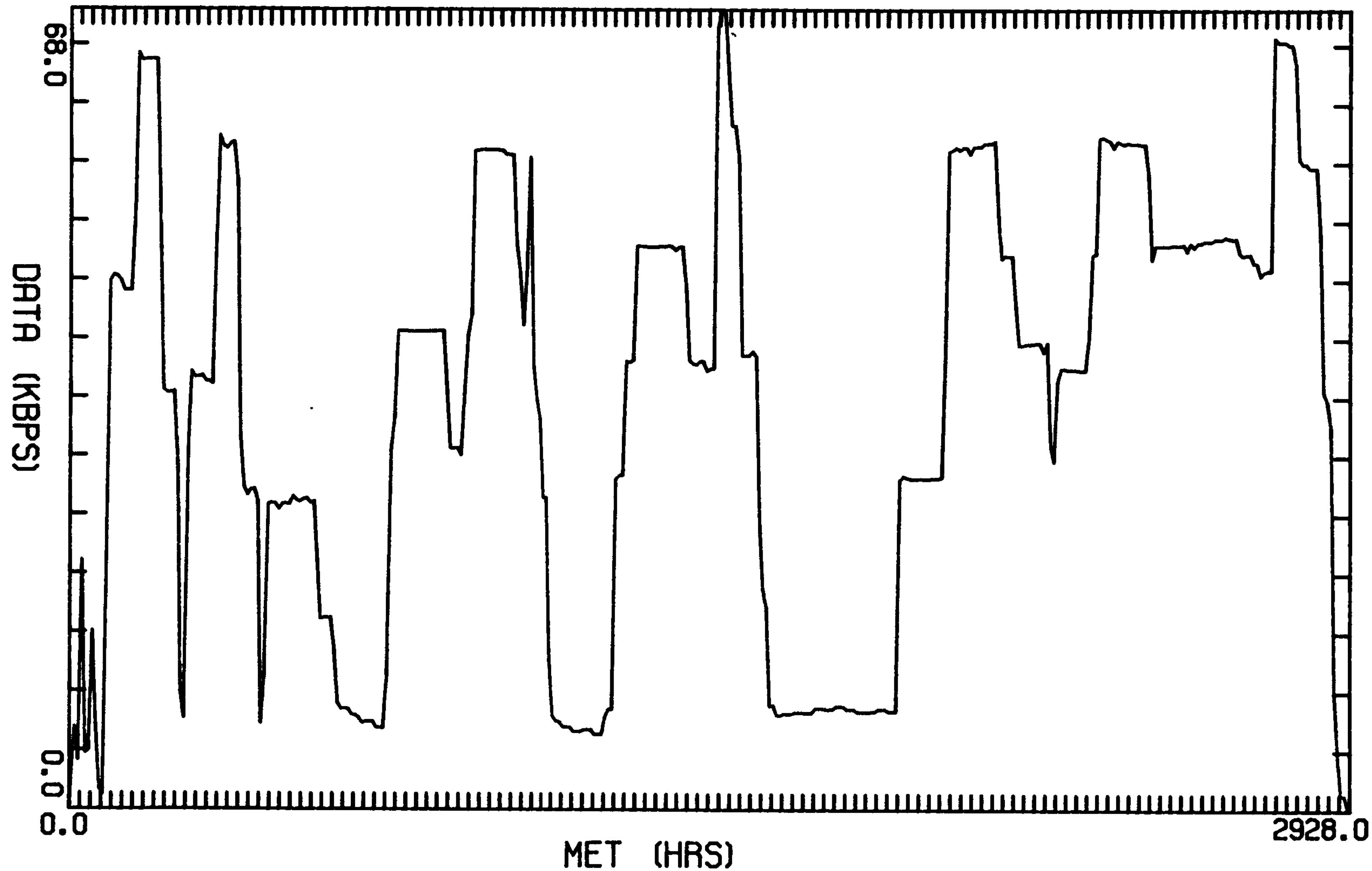

SCENARIO #12
1.5
0.0
CREW USAGE
0.0
4368.0
MET (HRS)


SCENARIO #13
10.3
0.0
POWER (KW)
0.0
2928.0
MET (HRS)

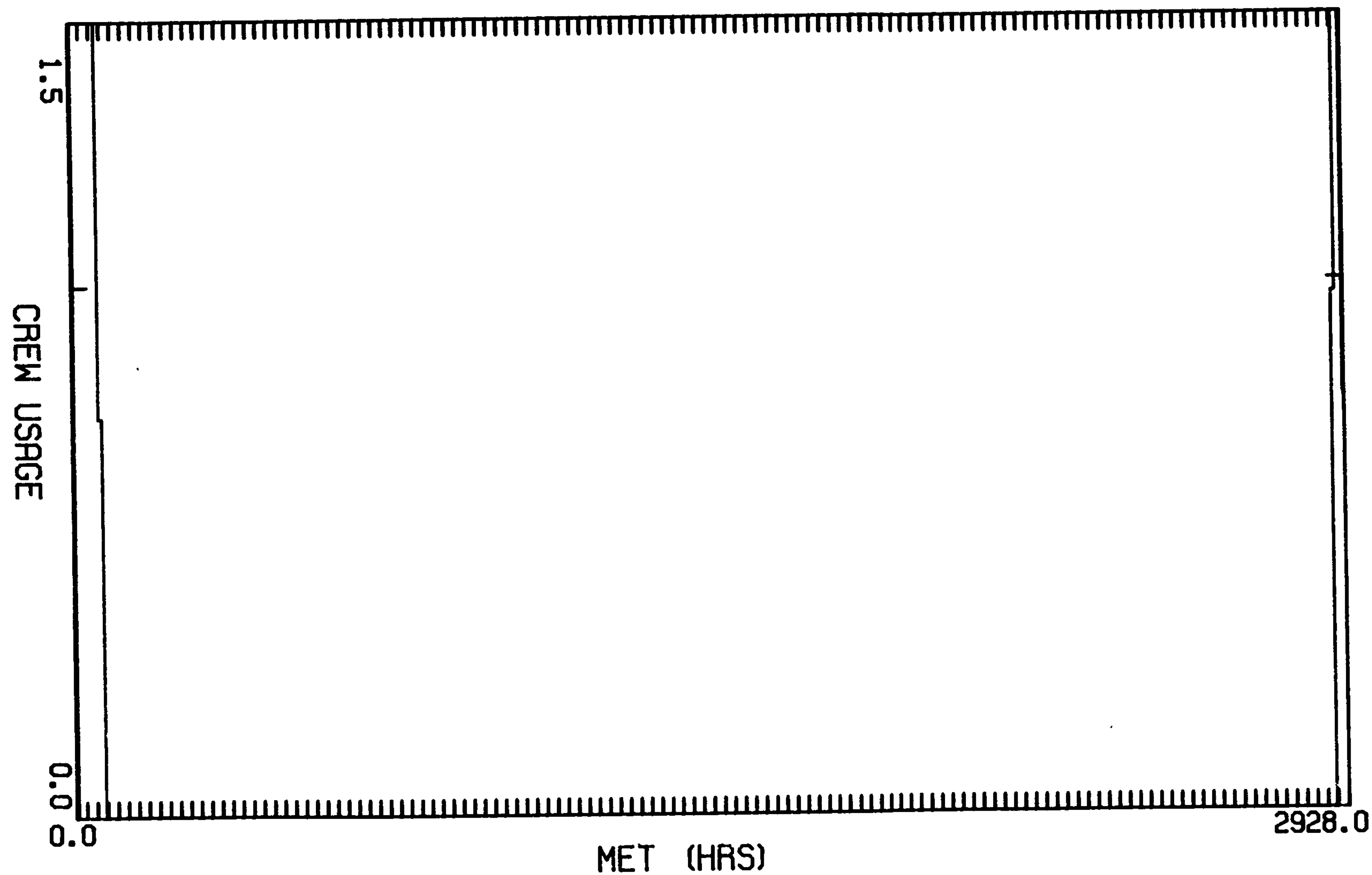
SCENARIO #13



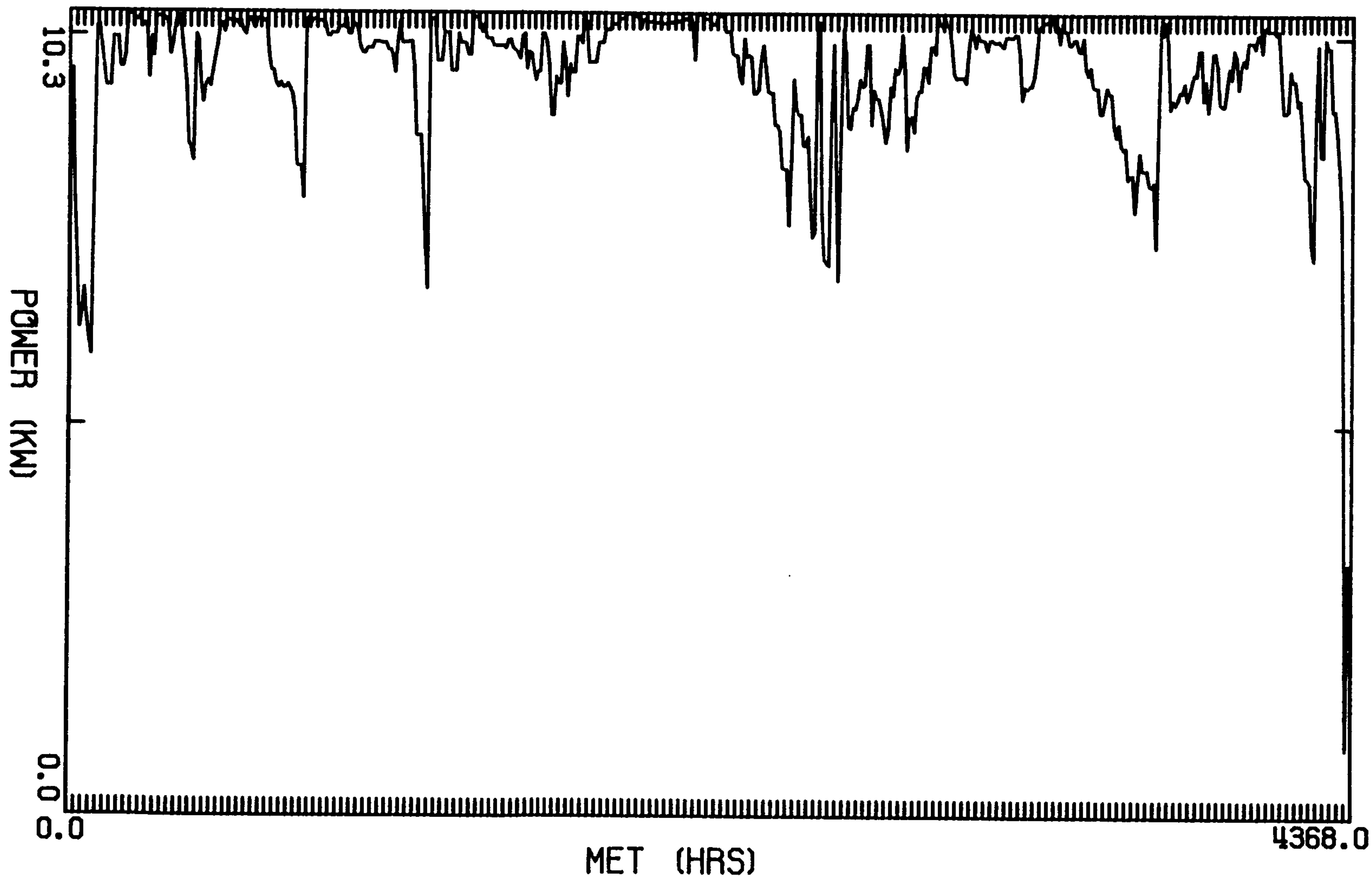
SCENARIO #13



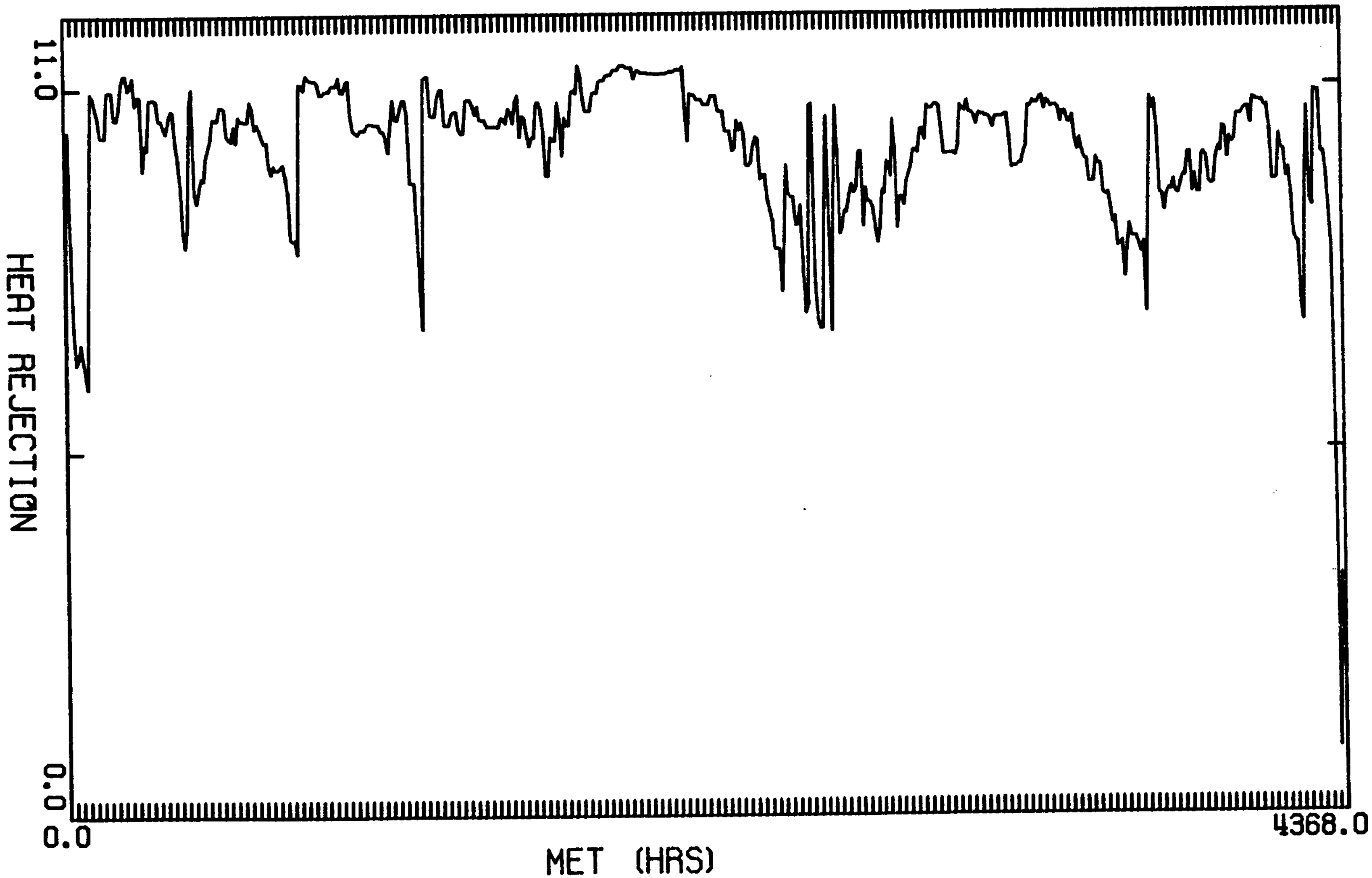
SCENARIO #13



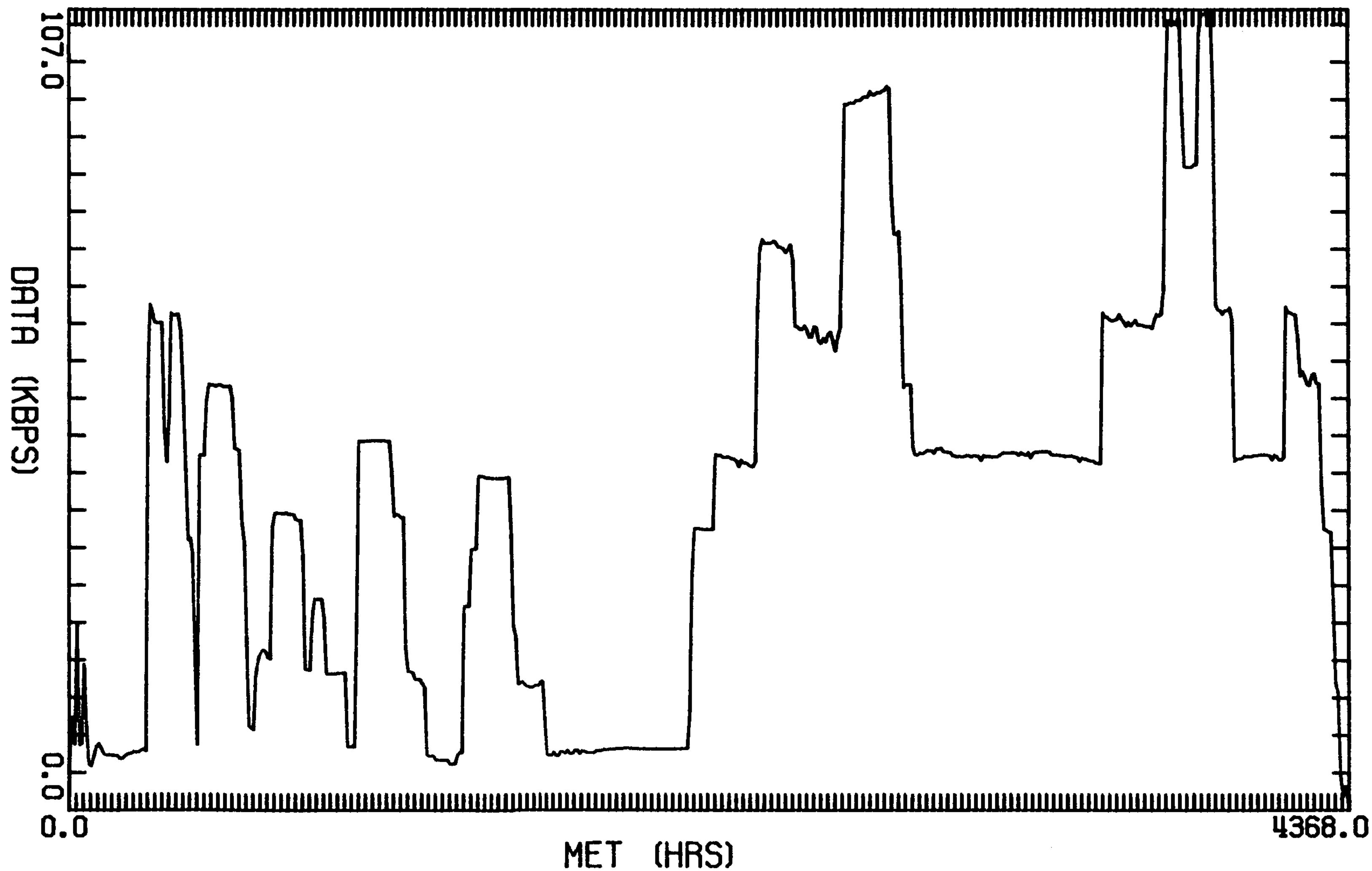
SCENARIO #14



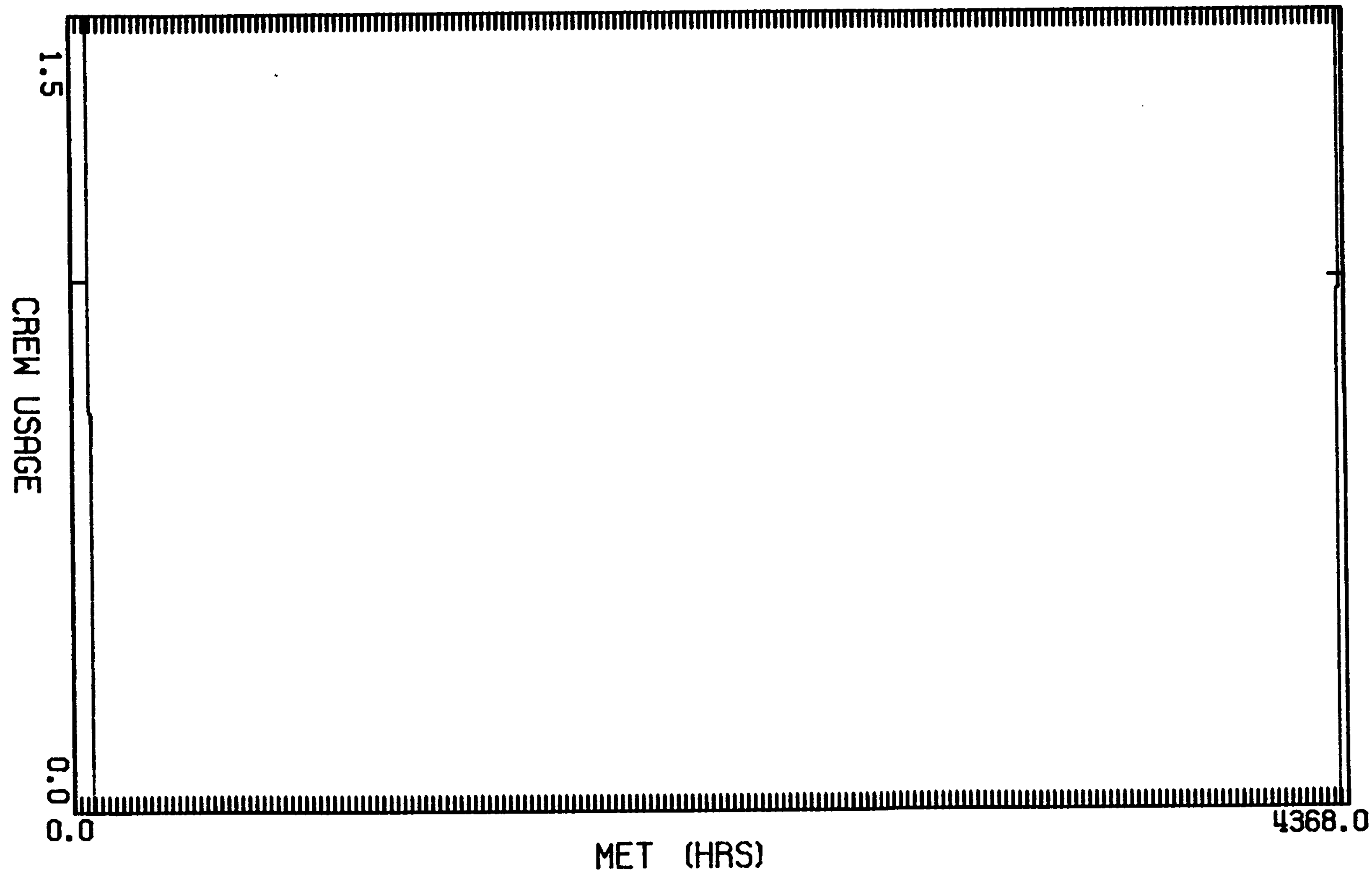
SCENARIO #14



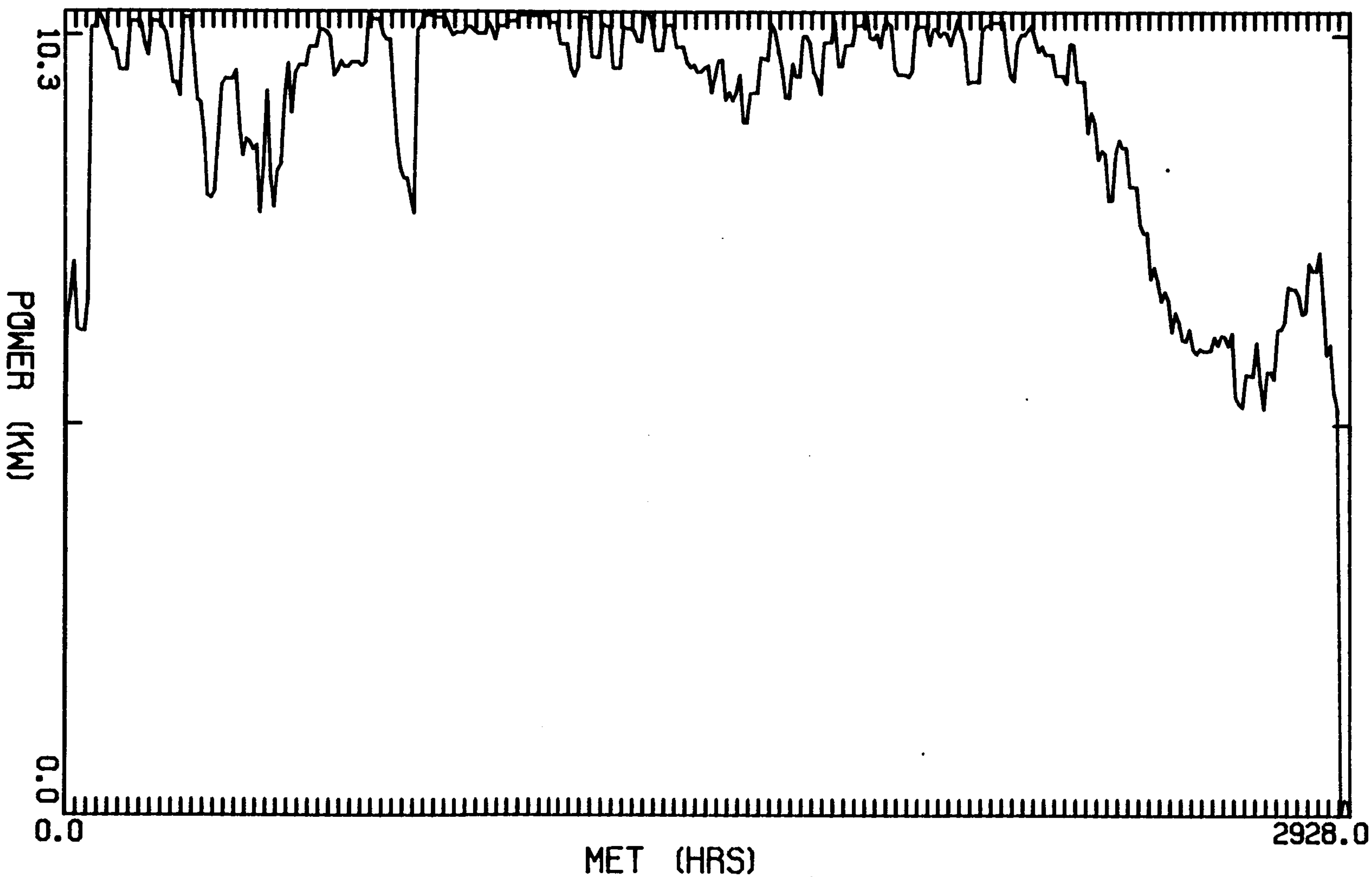
SCENARIØ #14



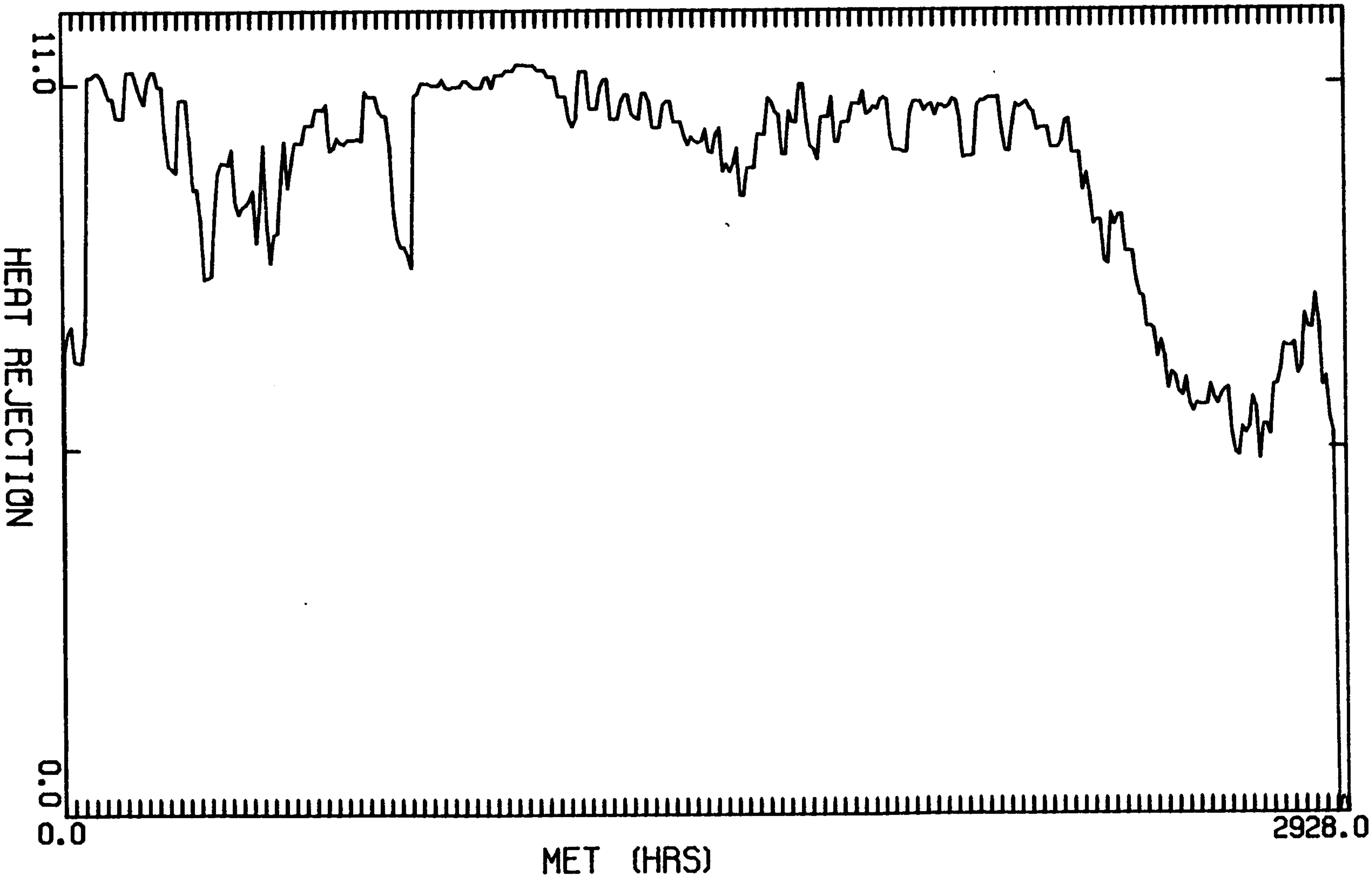
SCENARIO #14



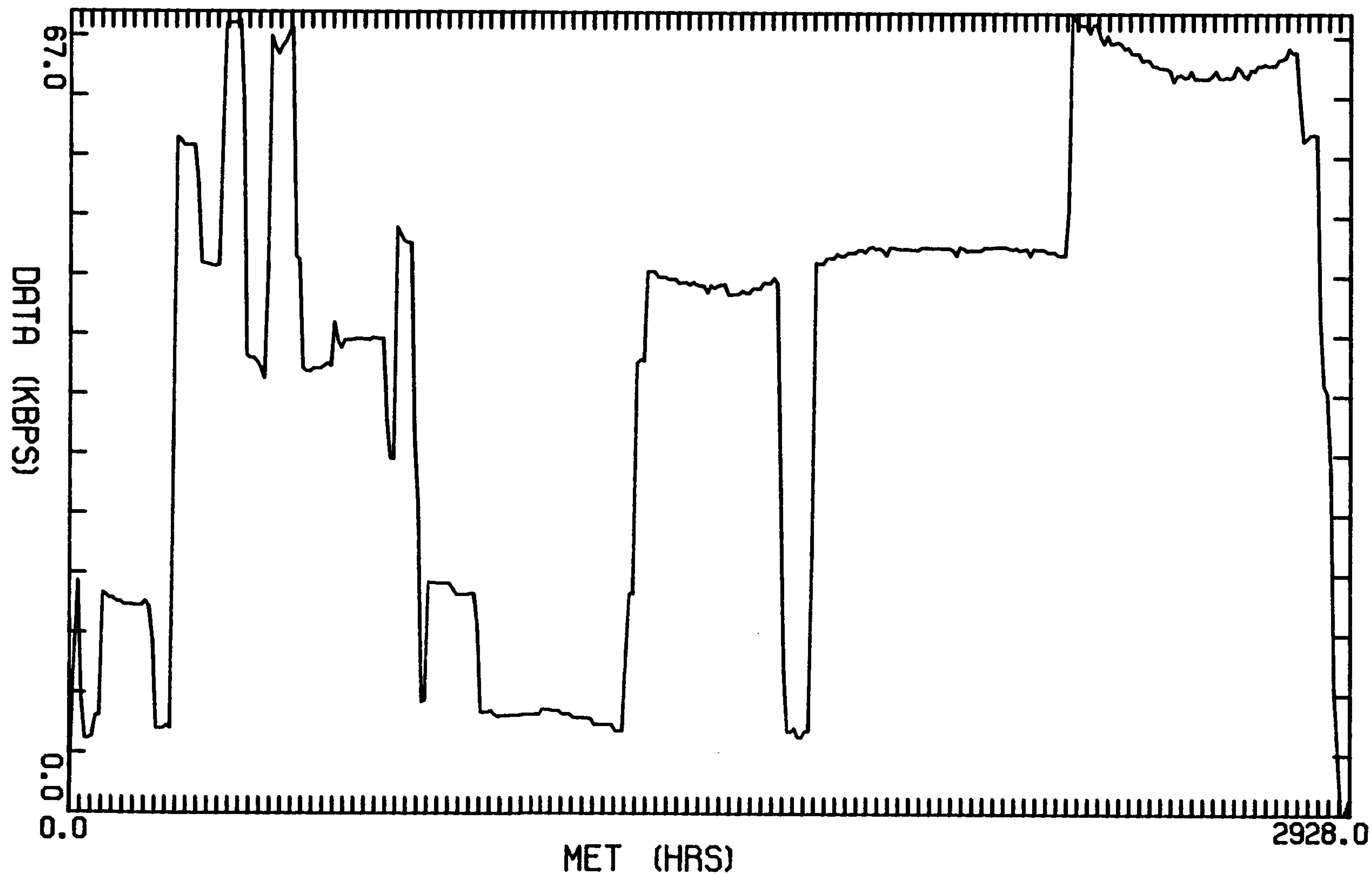
SCENARIO #5



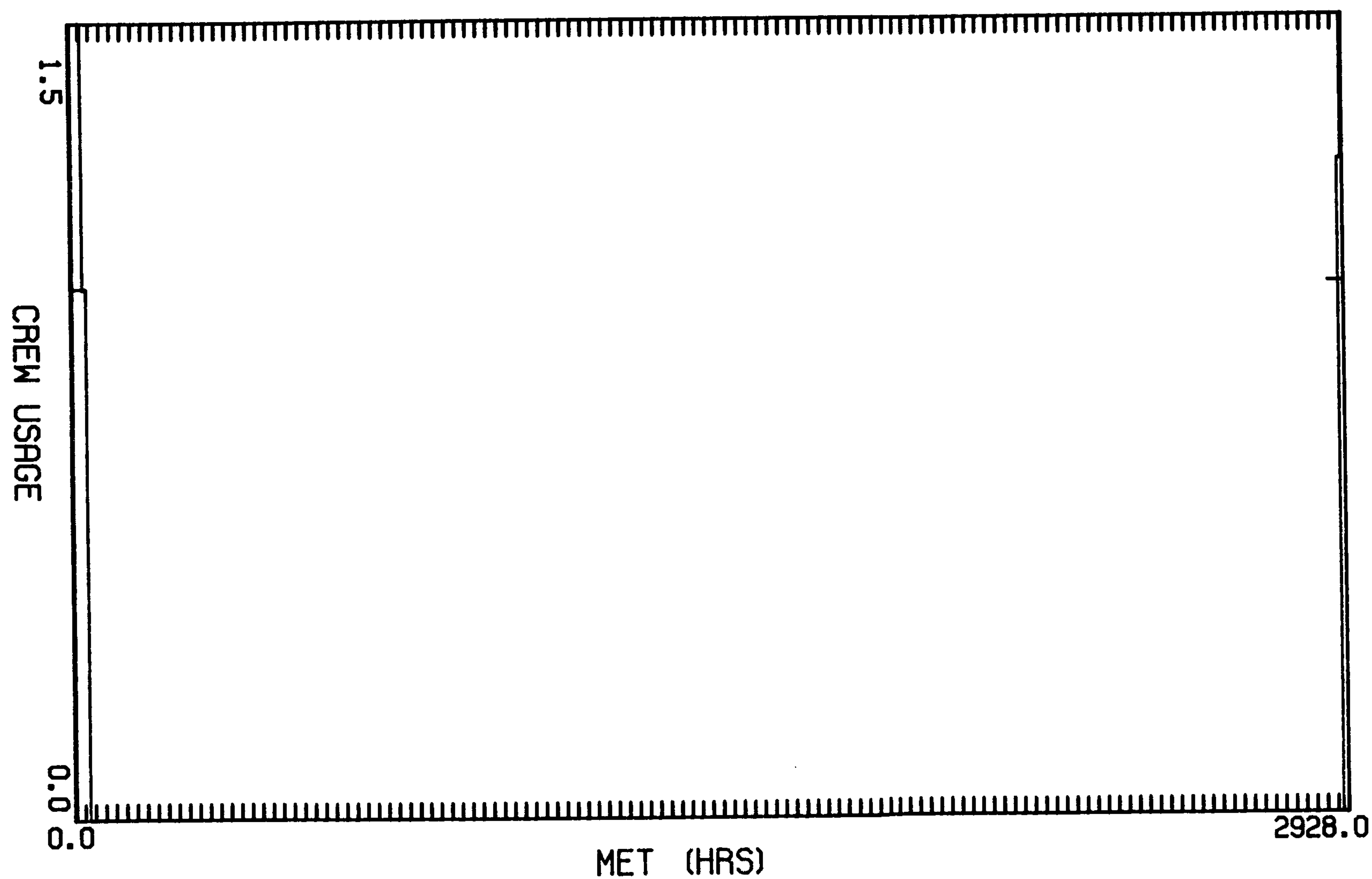
SCENARIO #15



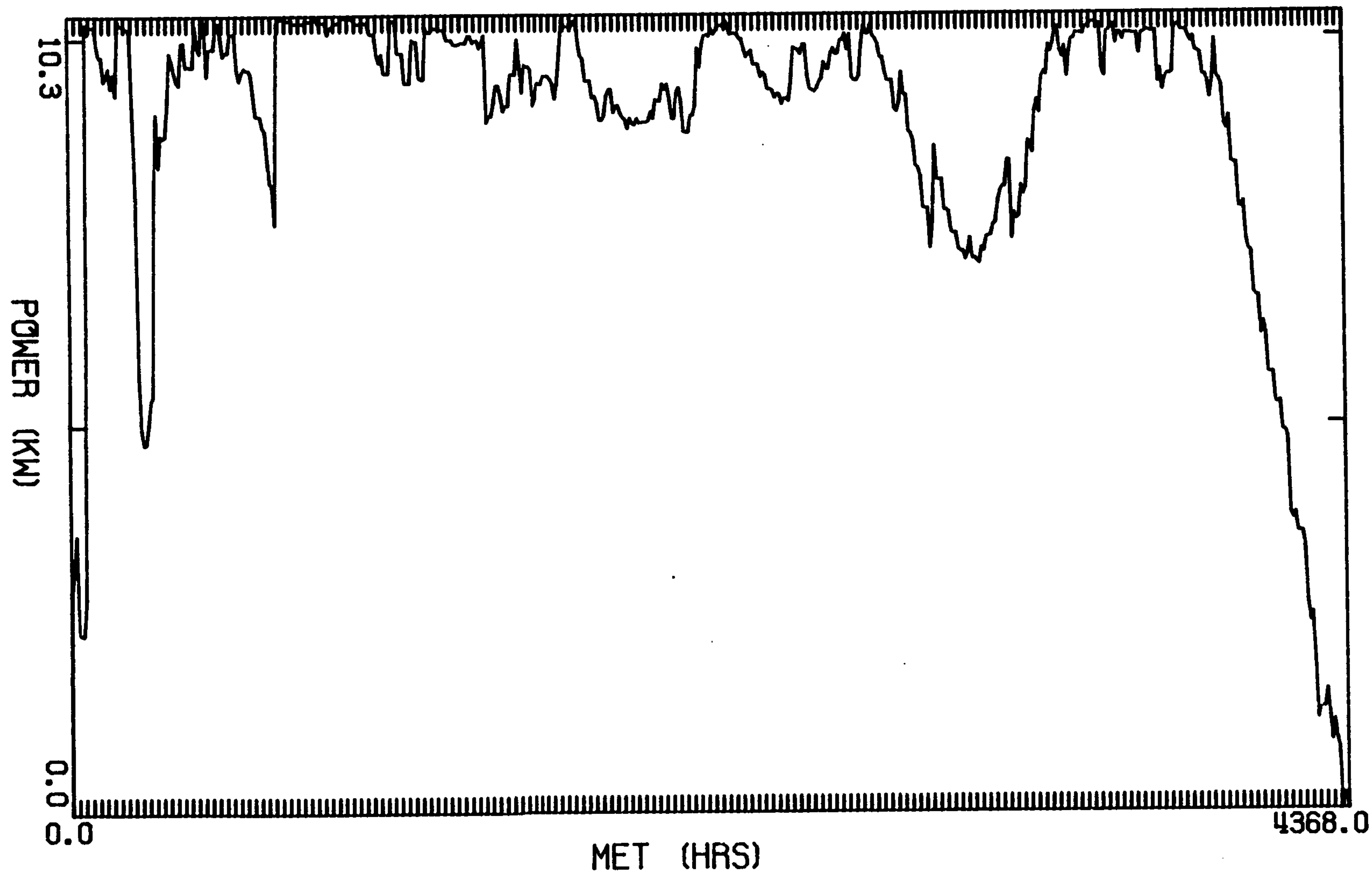
SCENARIO #15

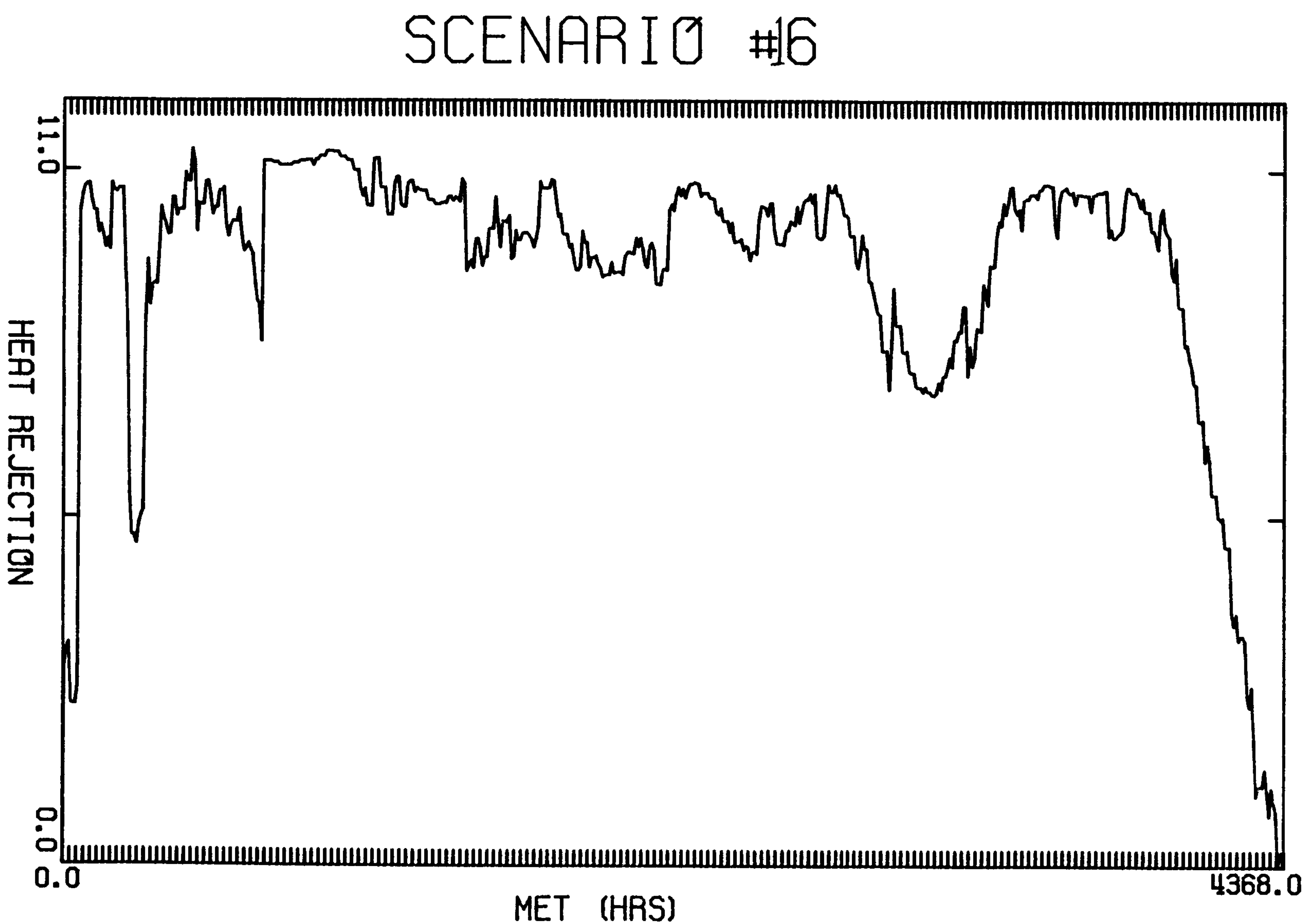


SCENARIO #15



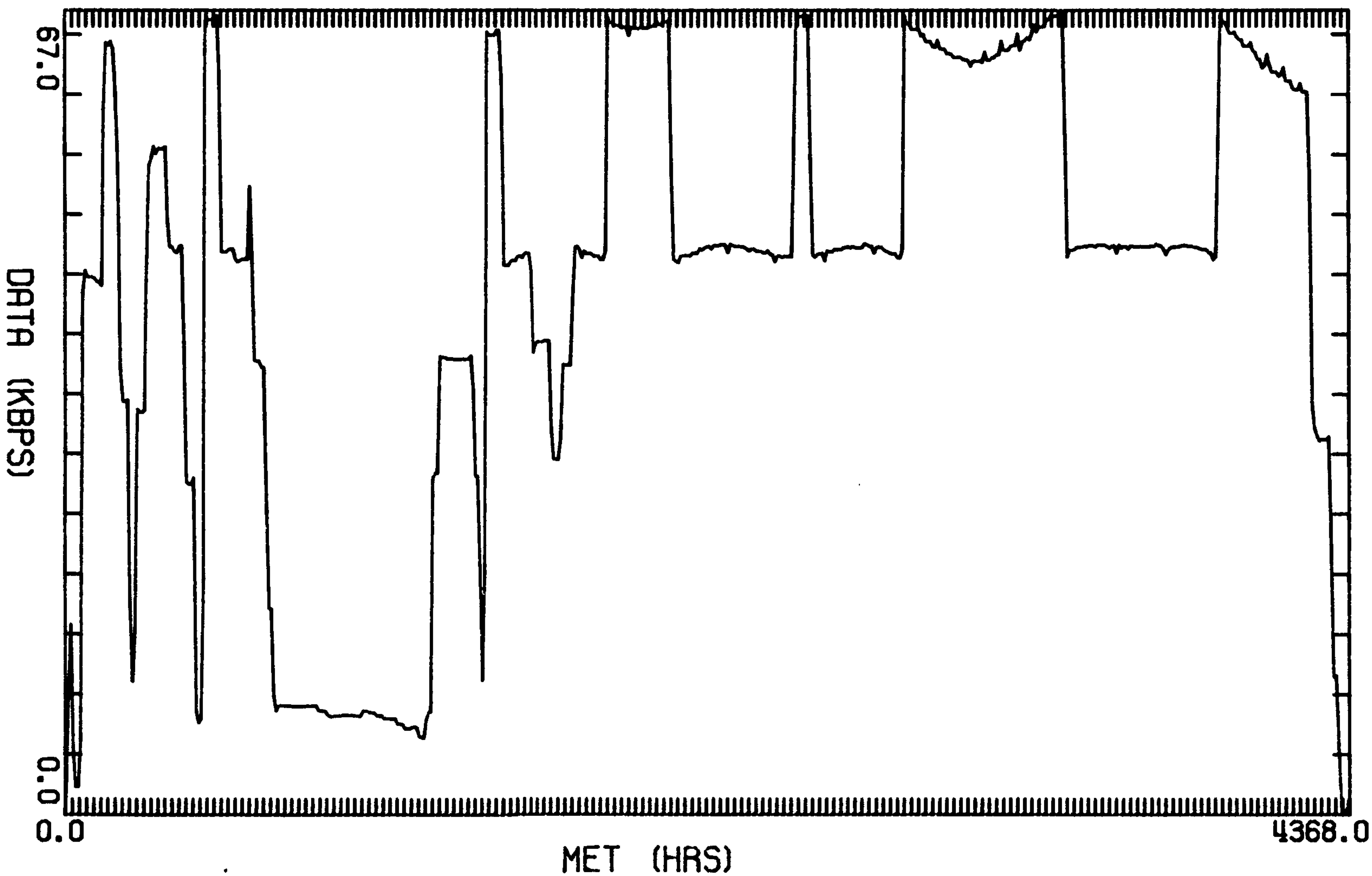
SCENARIO #16



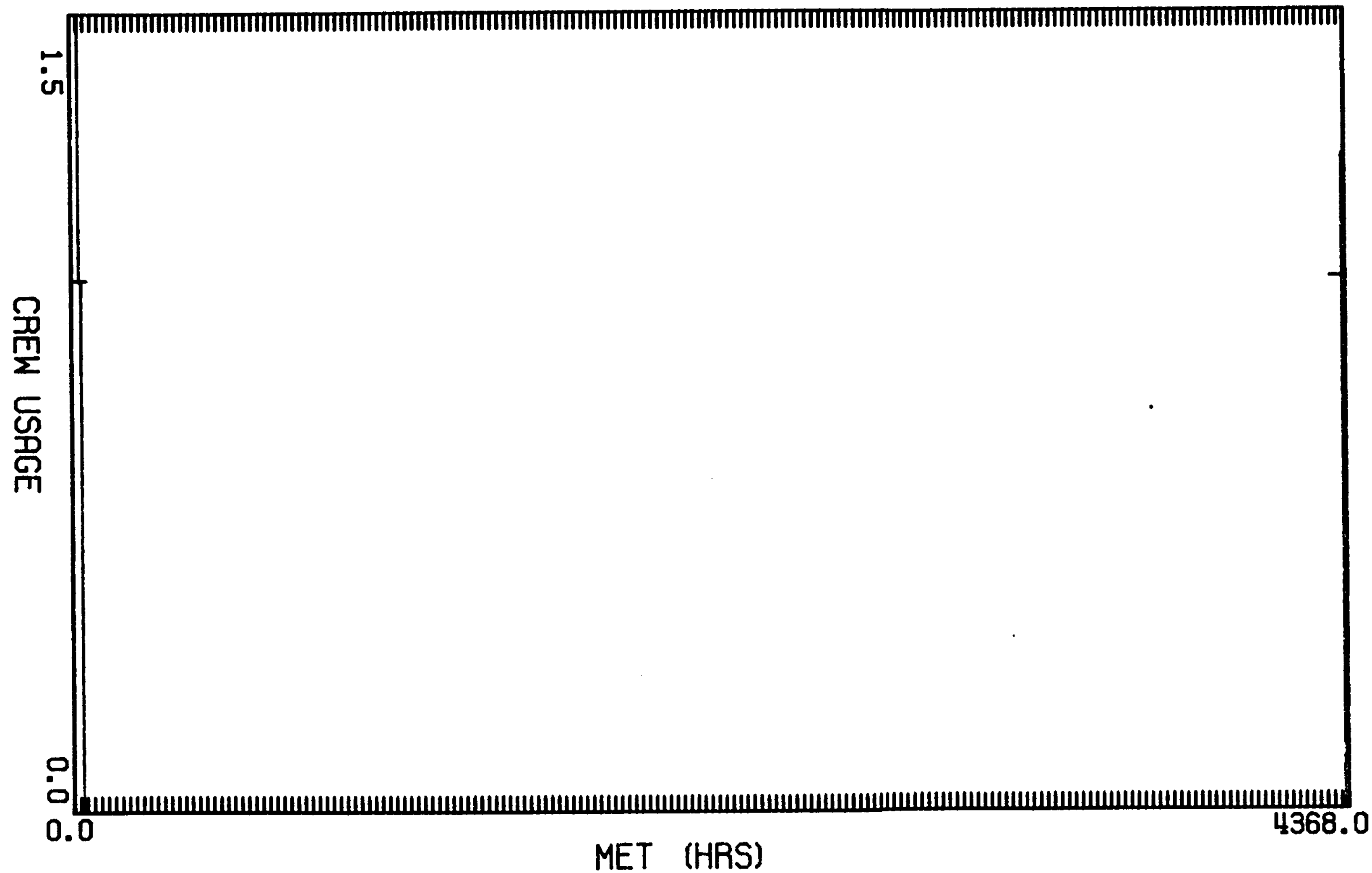


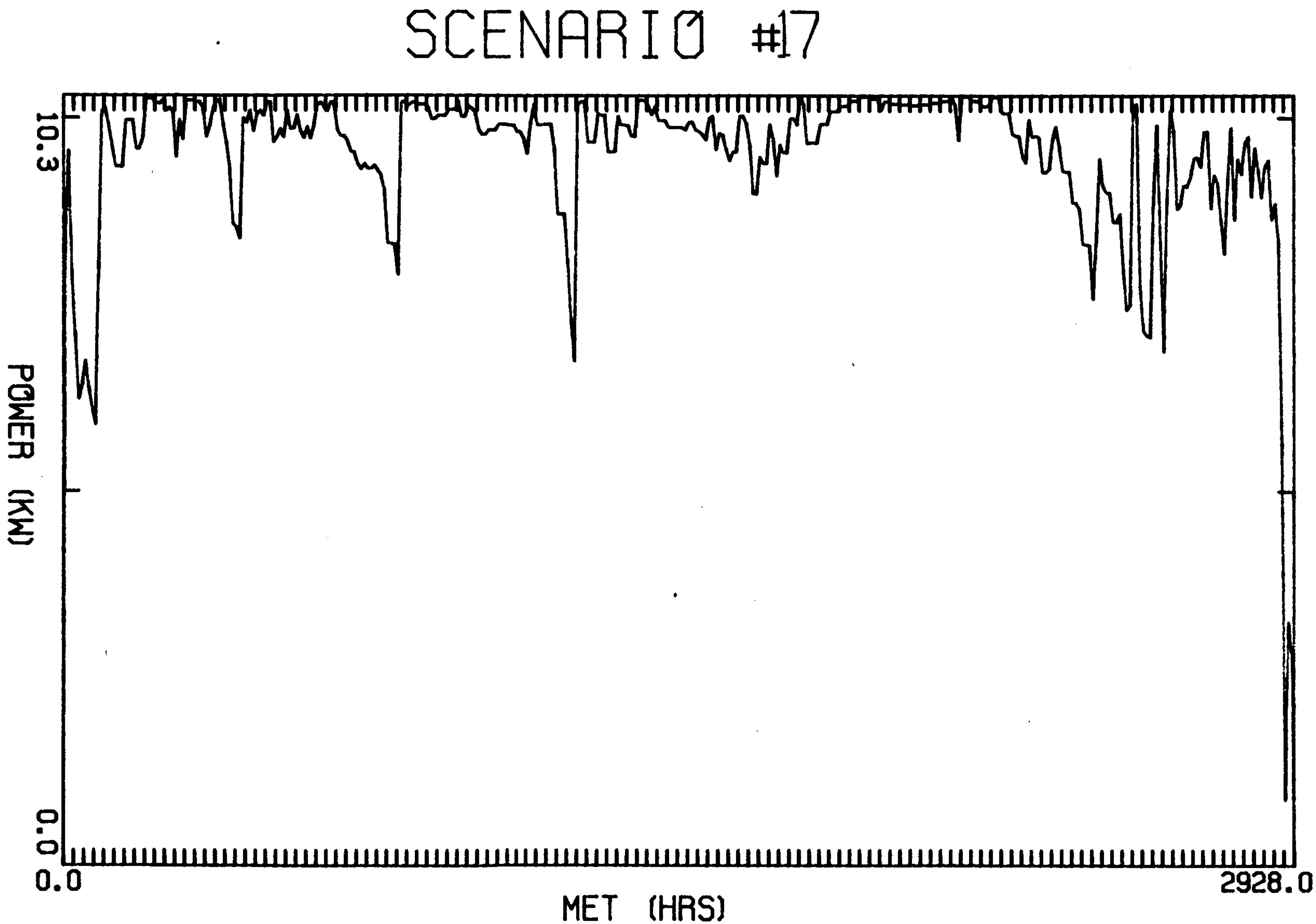
SCENARIØ #16
11.0
0.0
HEAT REJECTIØN
0.0
4368.0
MET (HRS)

SCENARIO #16

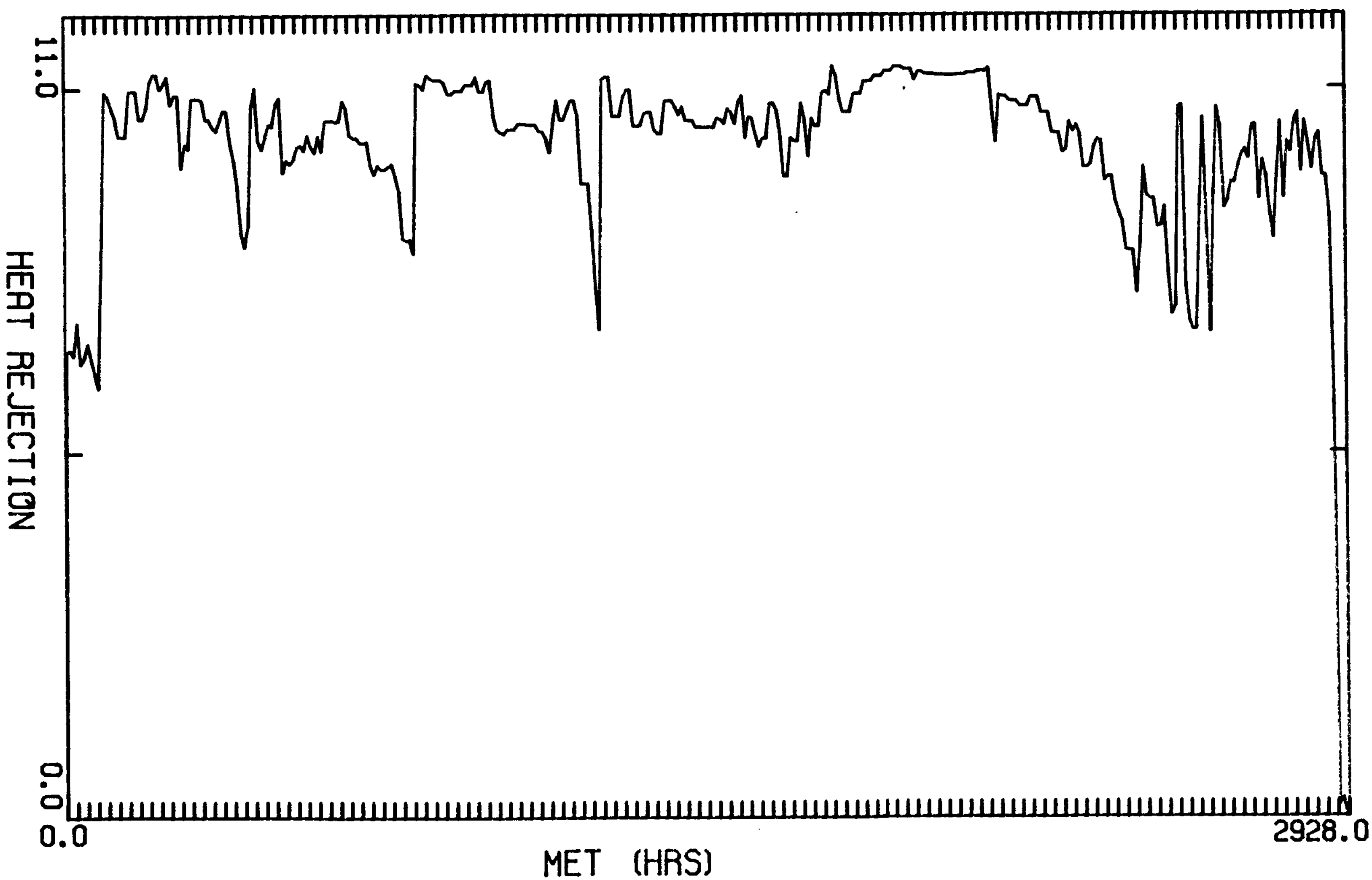


SCENARIO #16

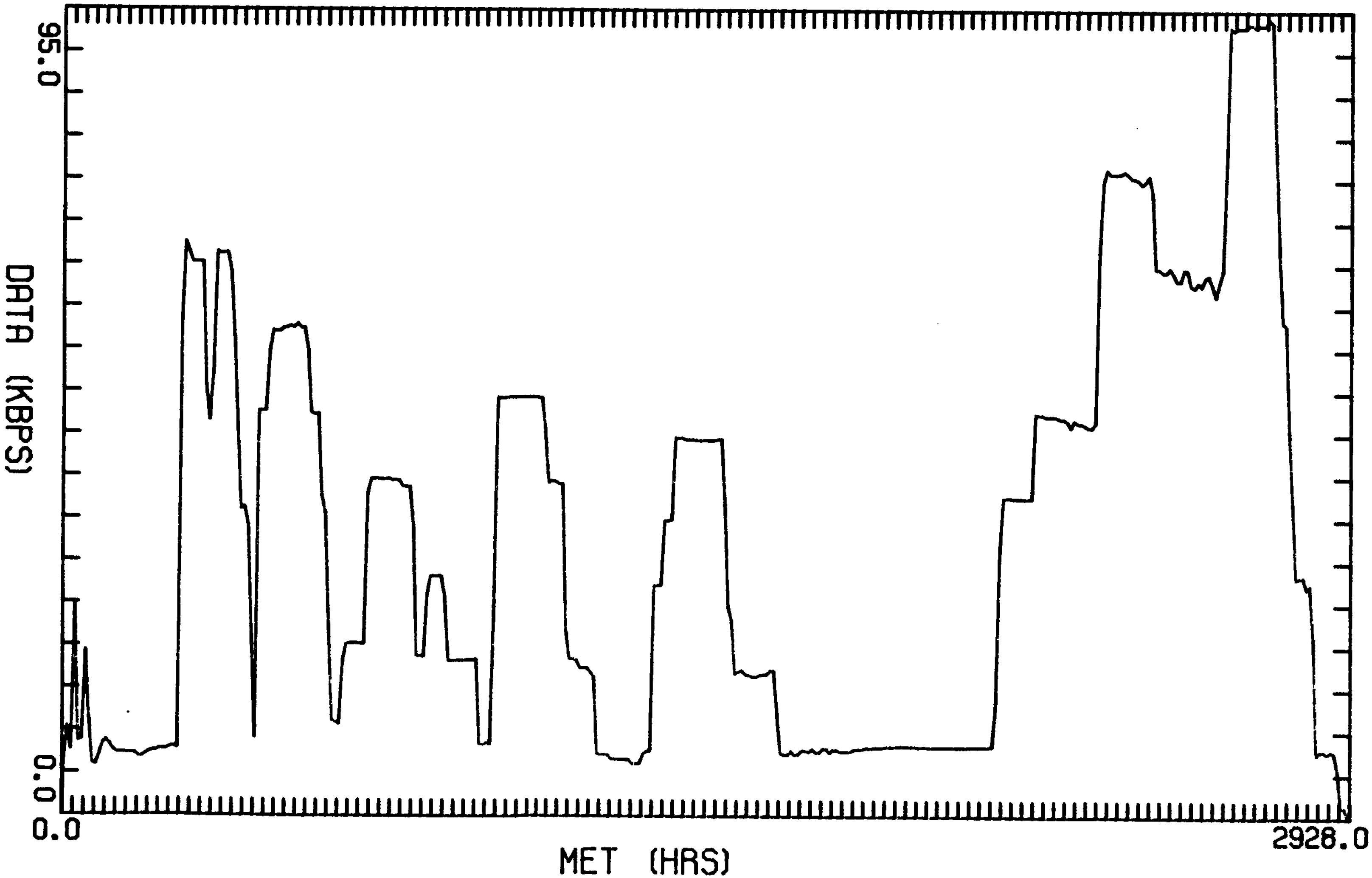



SCENARIO #17
10.3
0.0
POWER (KW)
0.0
2928.0
MET (HRS)

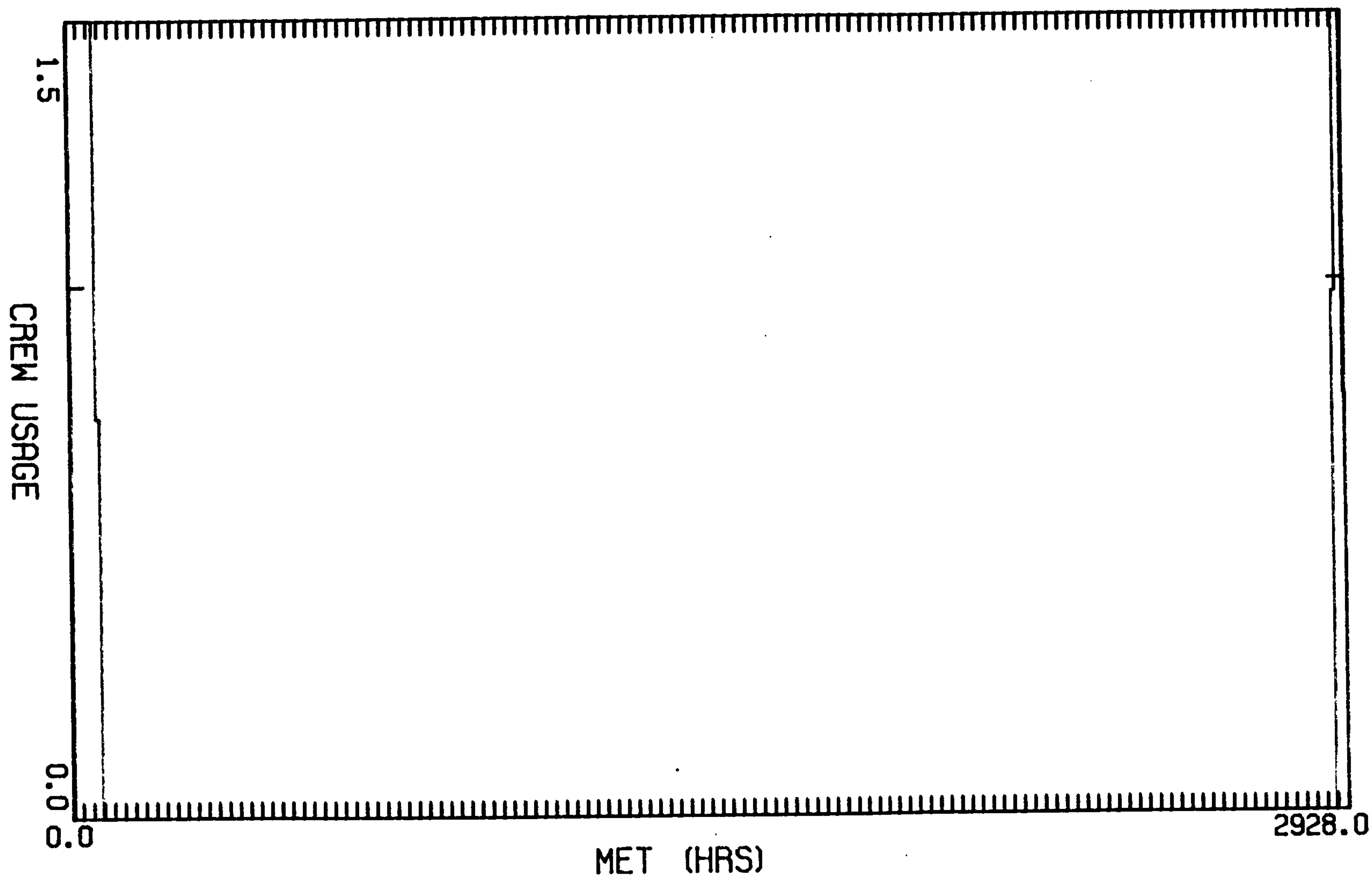
SCENARIO #17



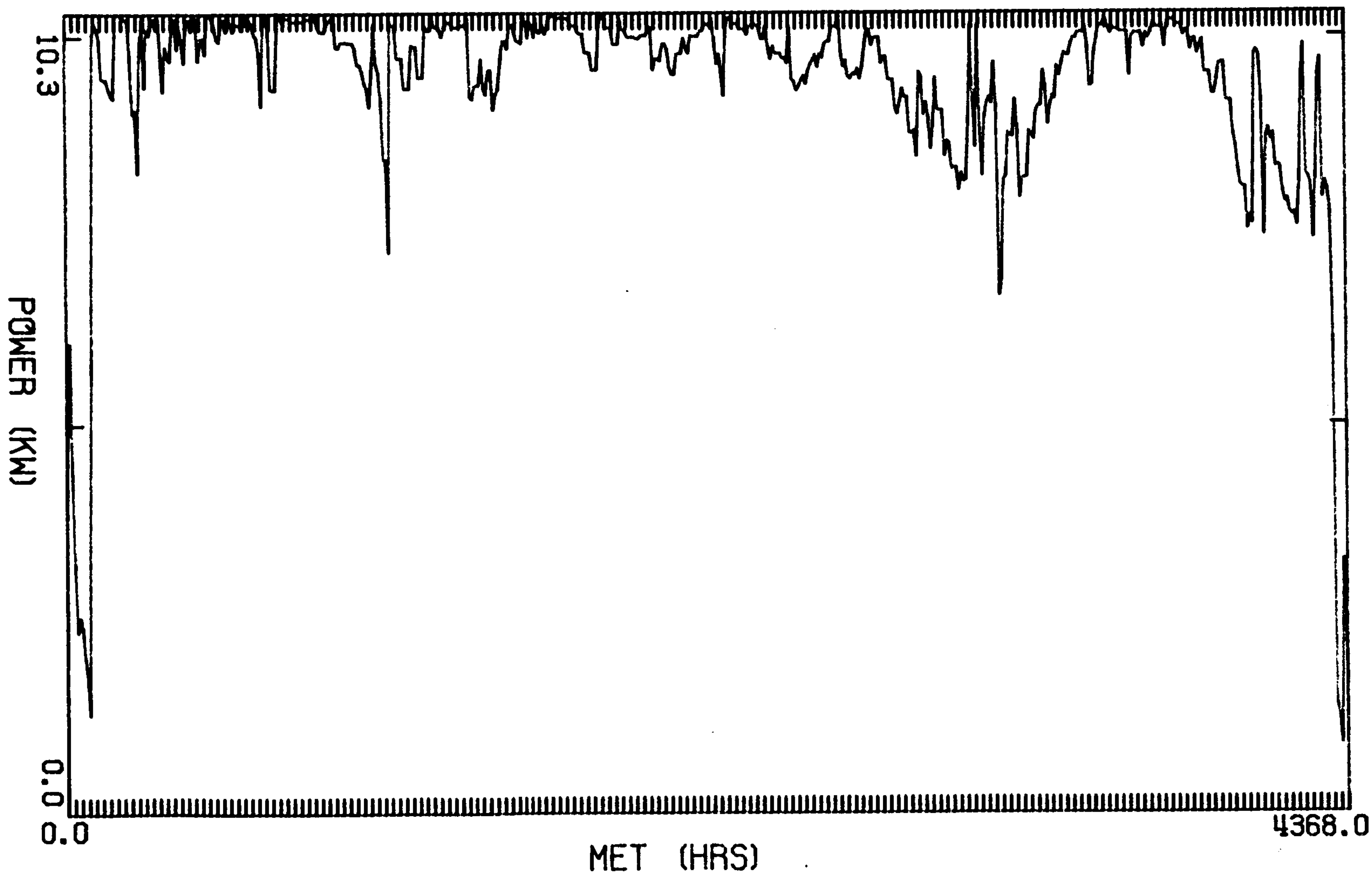
SCENARIO #17



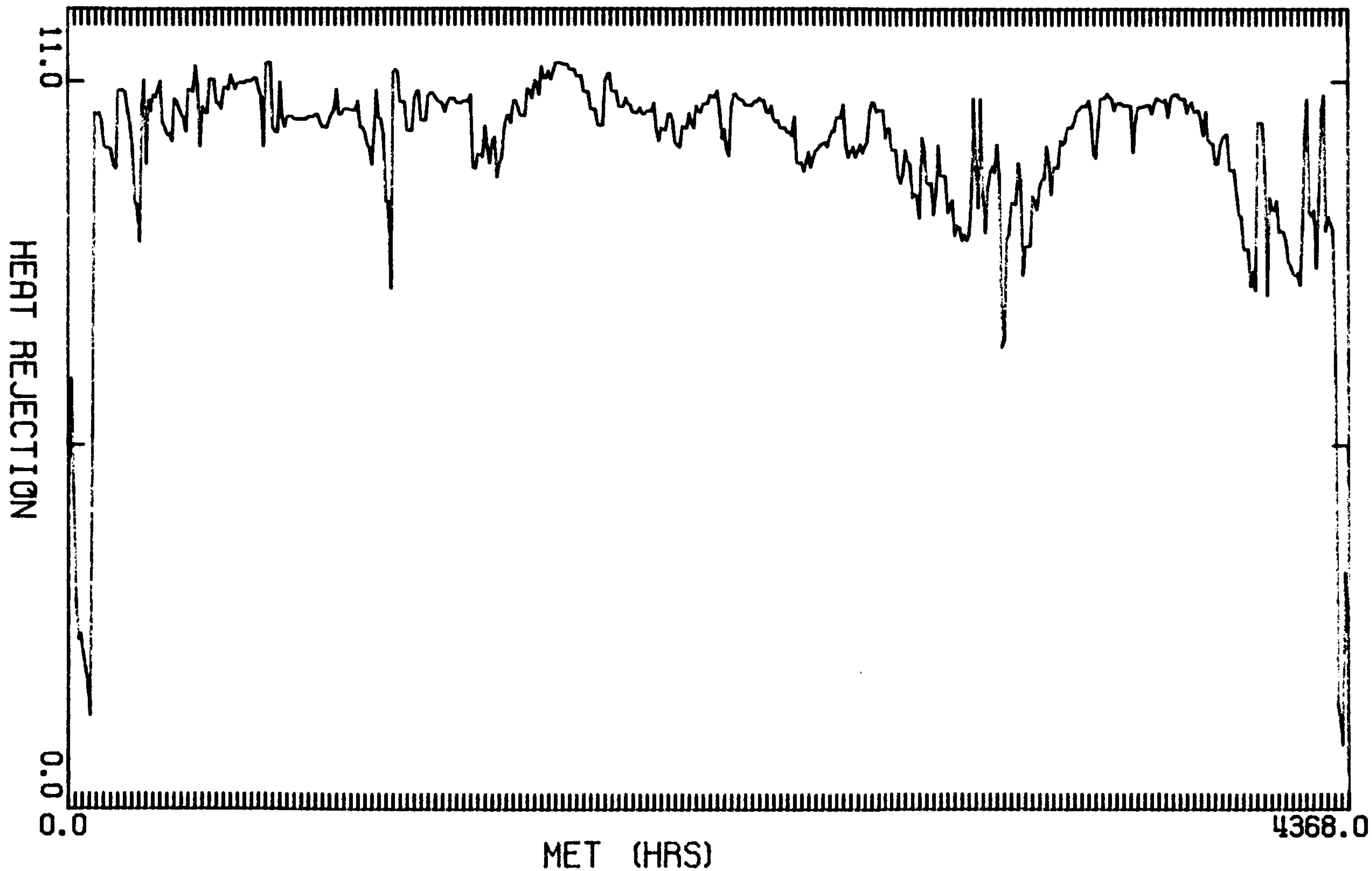
SCENARIO #17



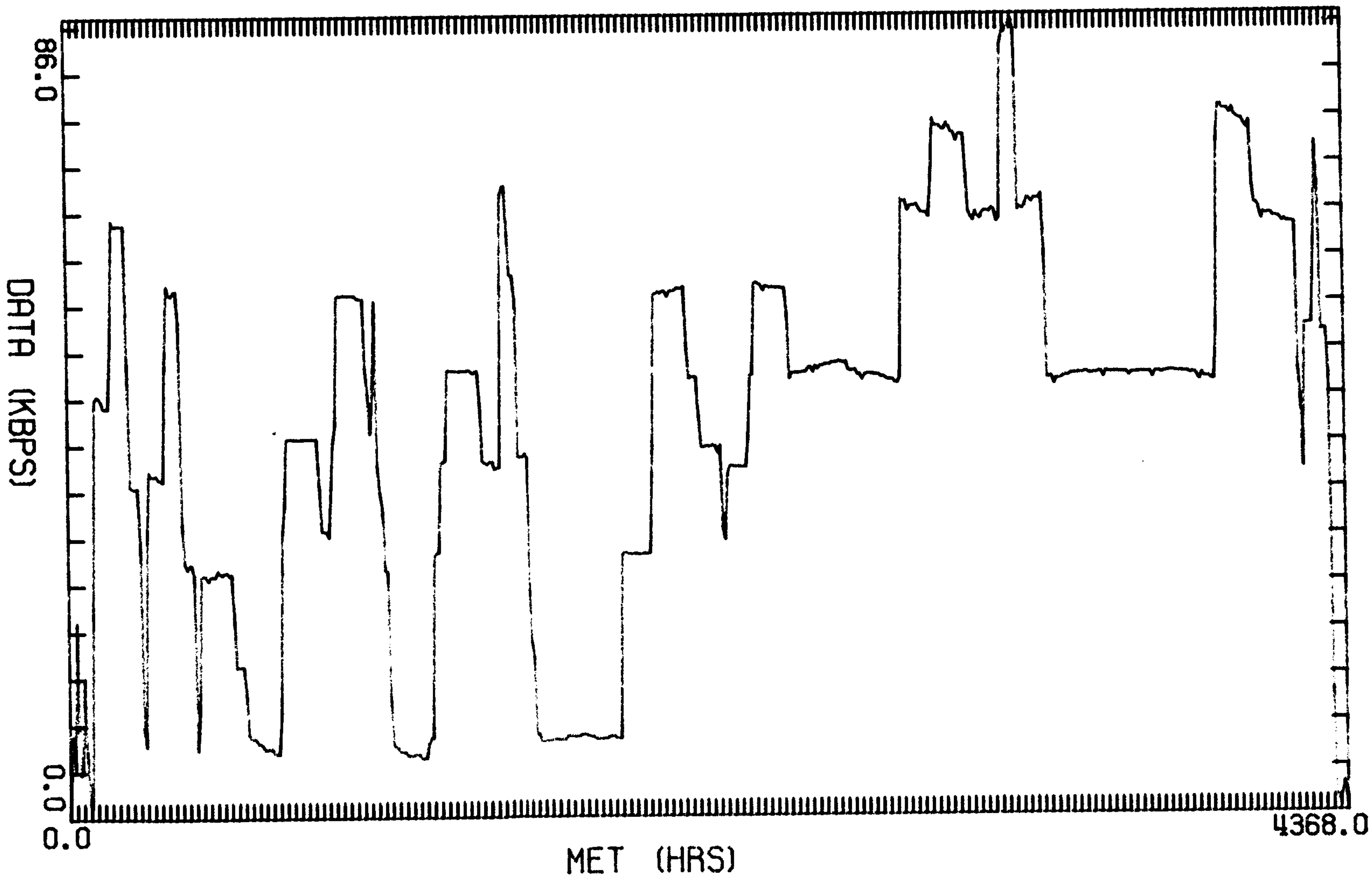
SCENARIO #18



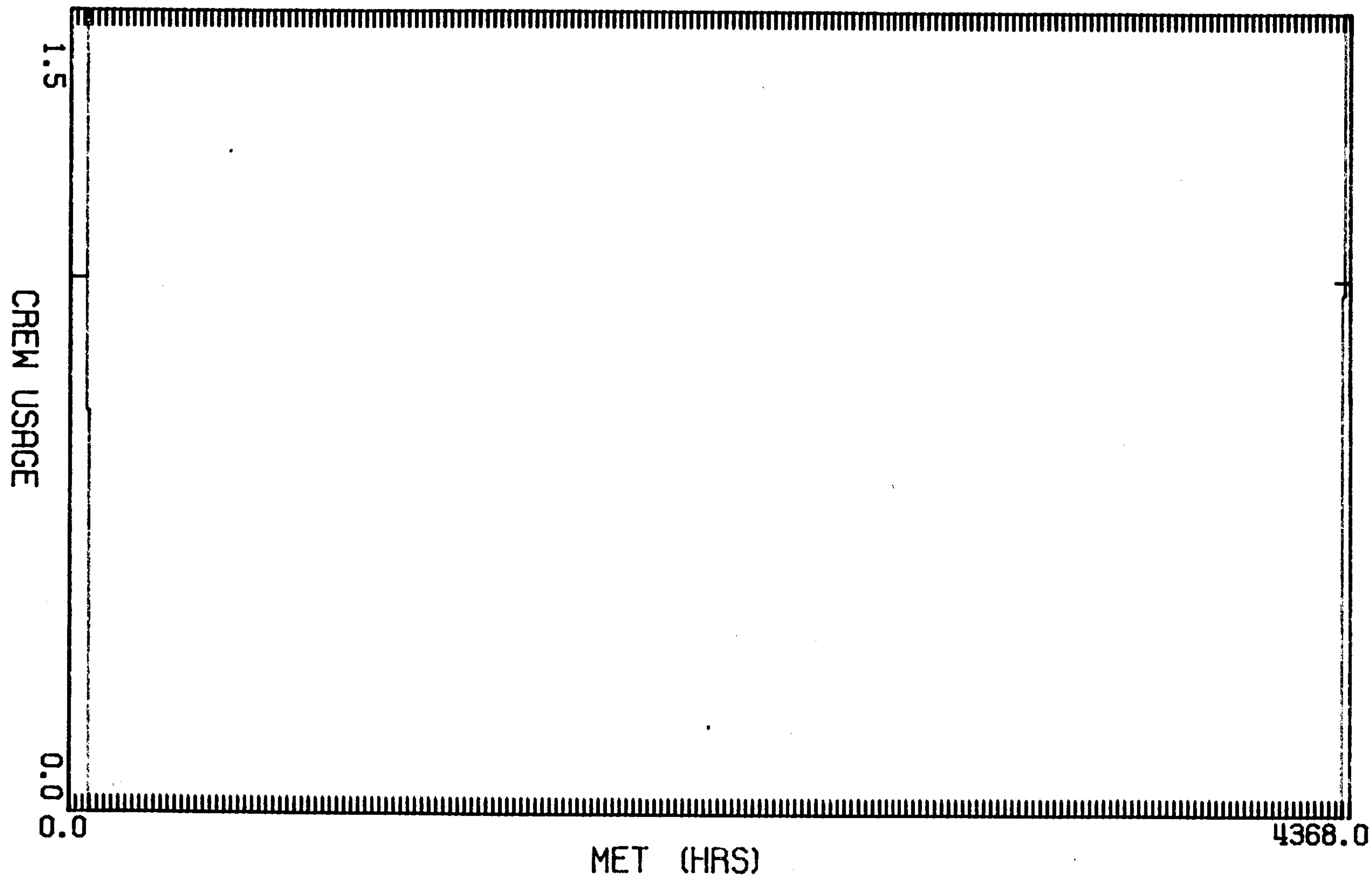
SCENARIØ #18



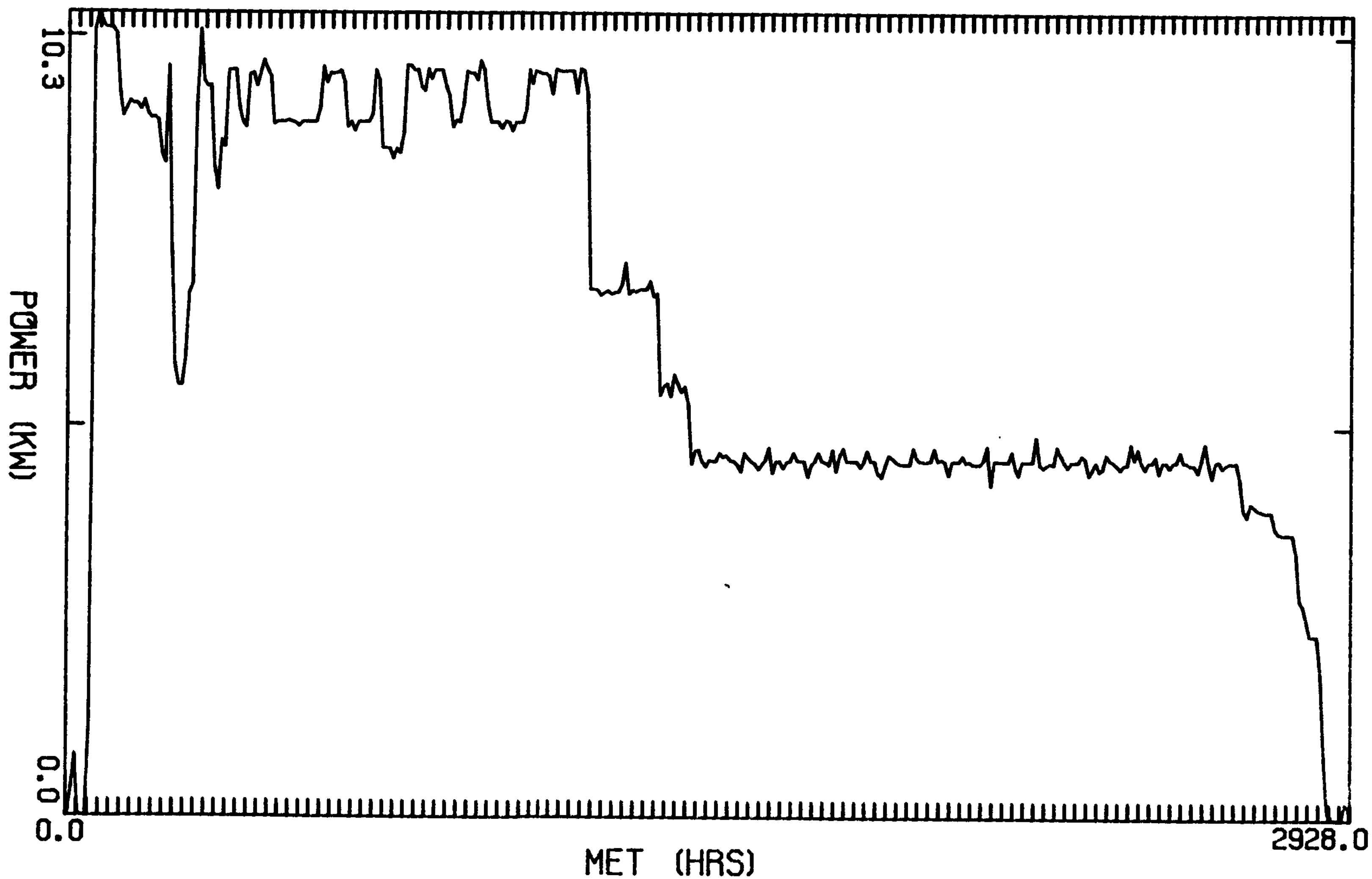
SCENARIO #18



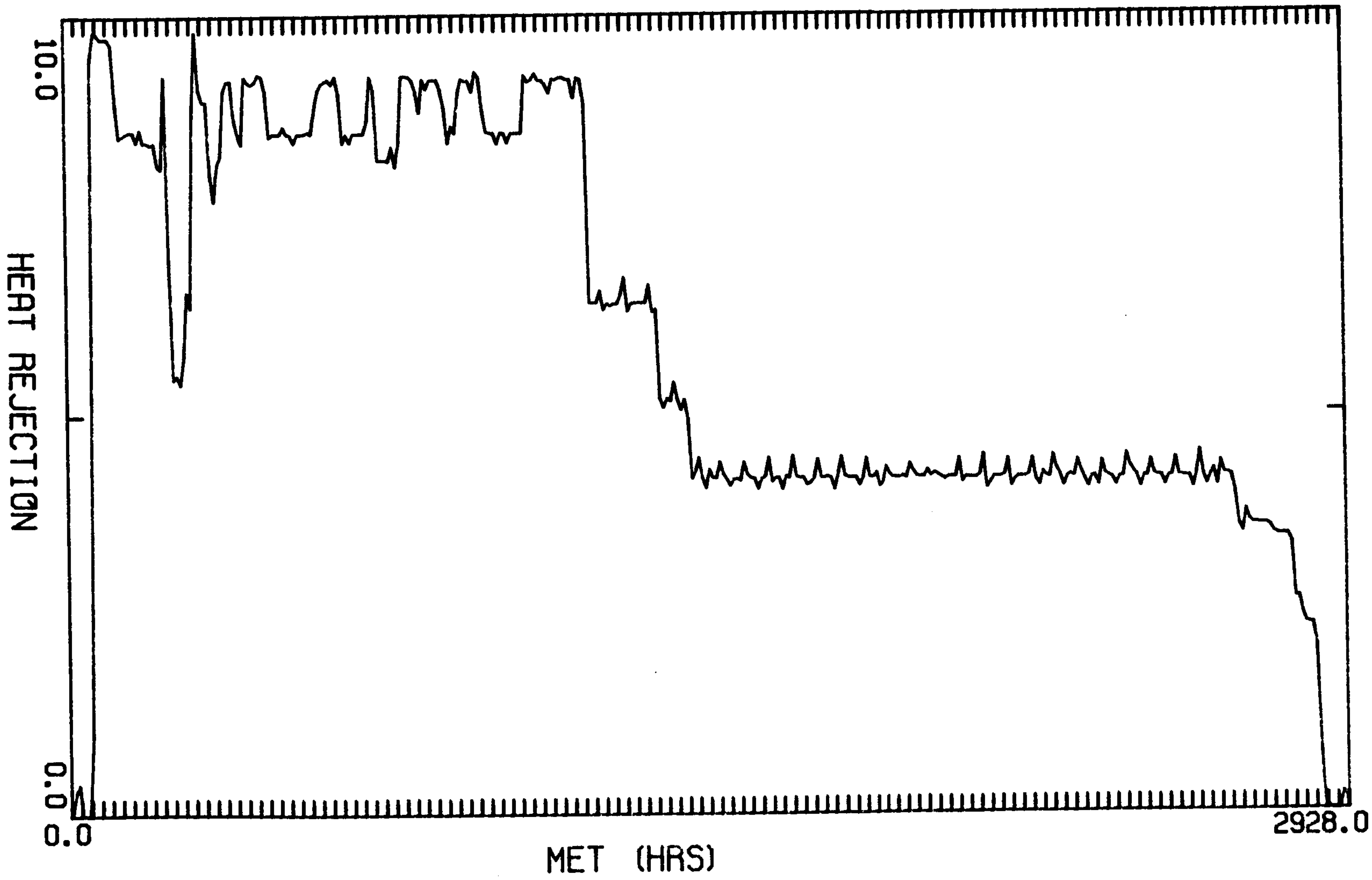
SCENARIO #18



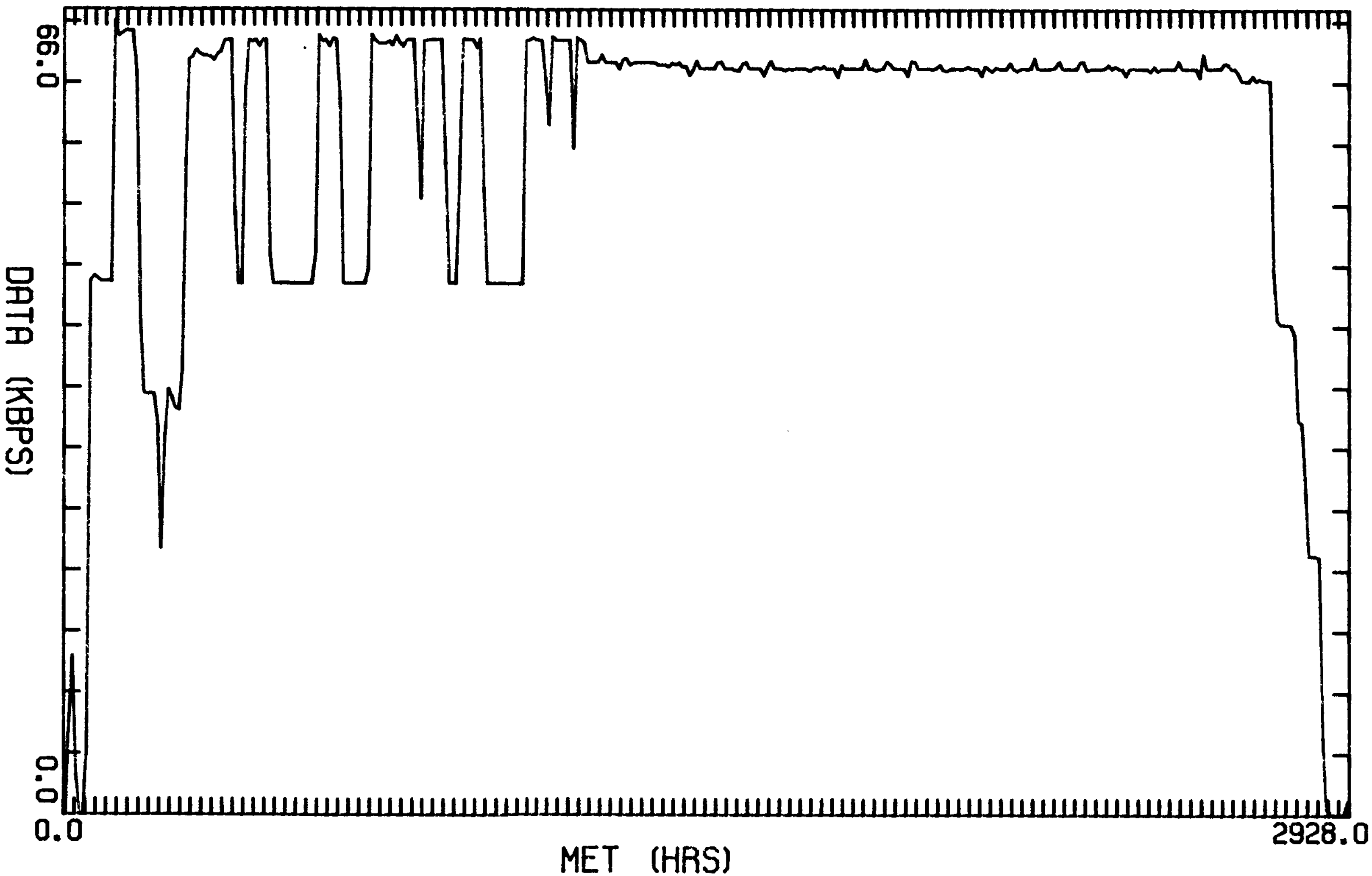
SCENARIØ #19



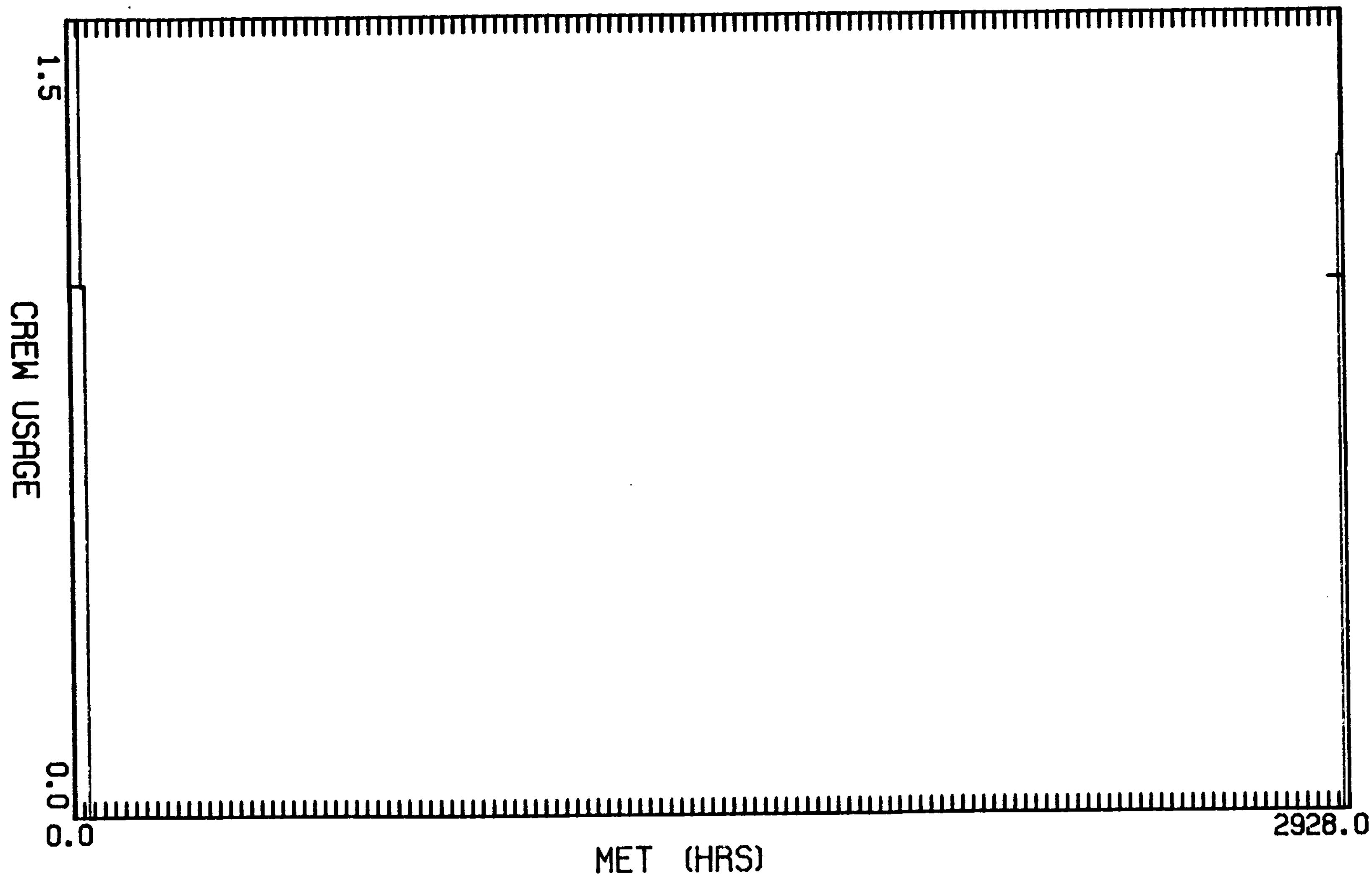
SCENARIO #19



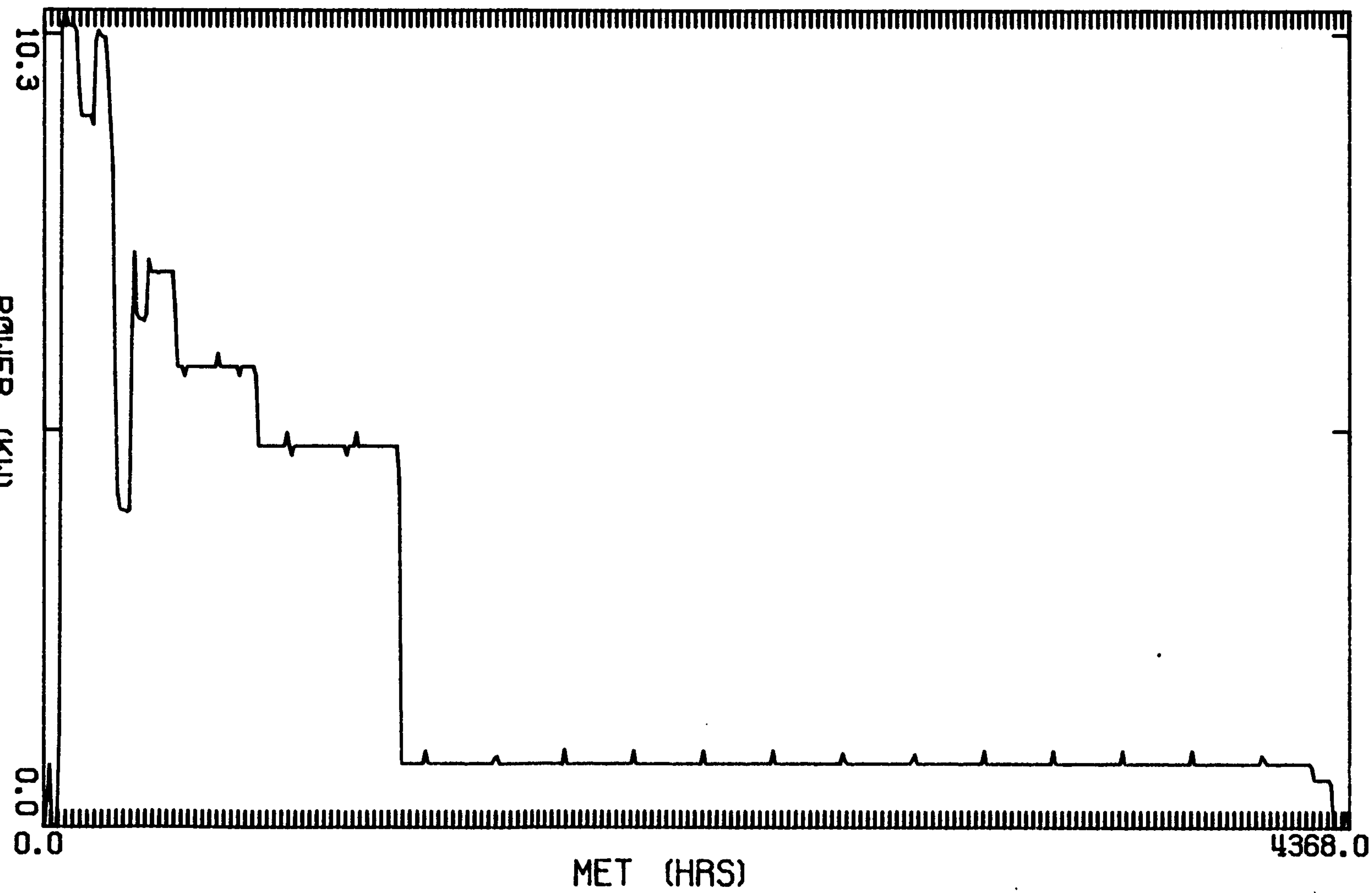
SCENARIO #19



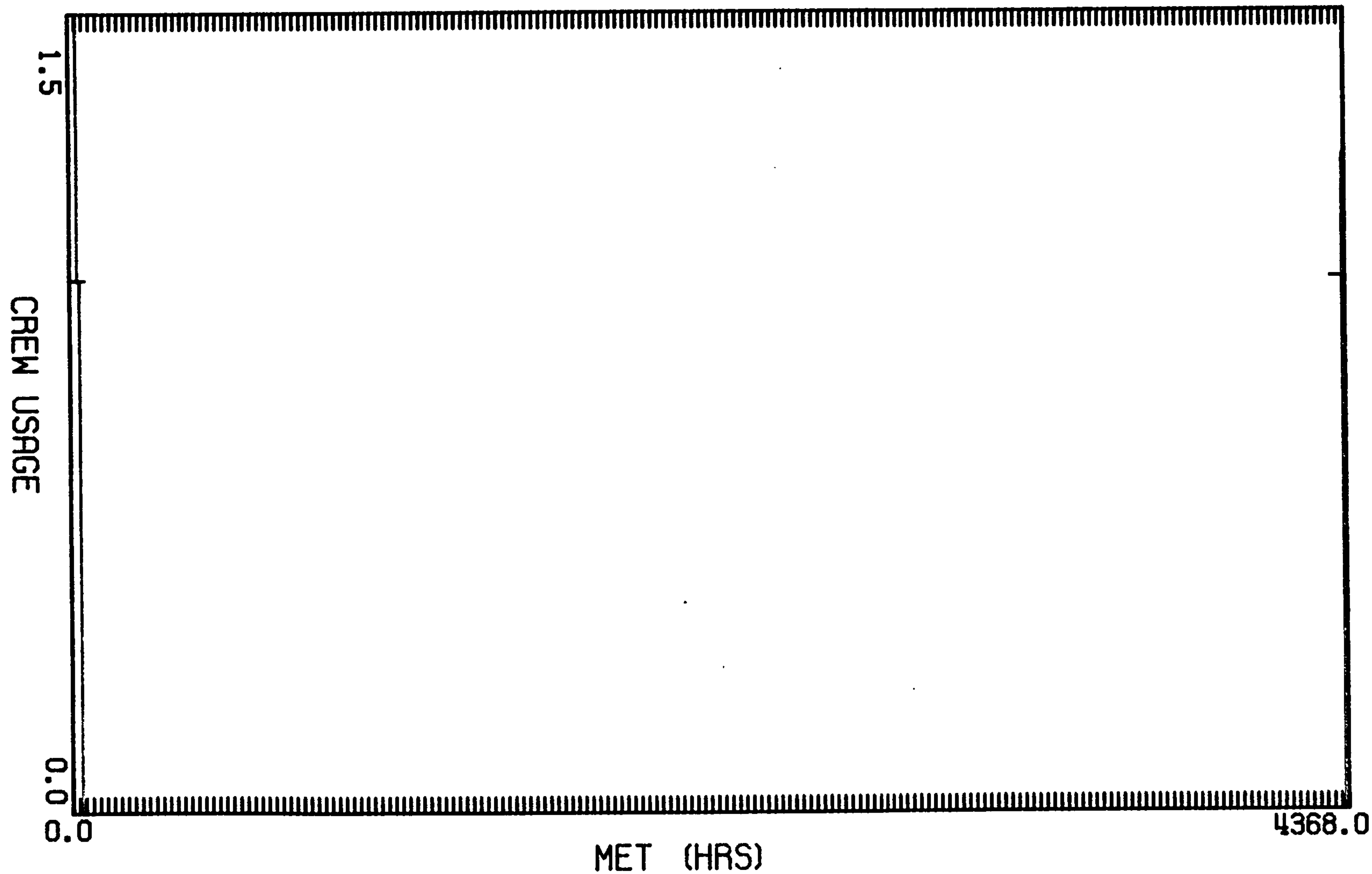
SCENARIO #19



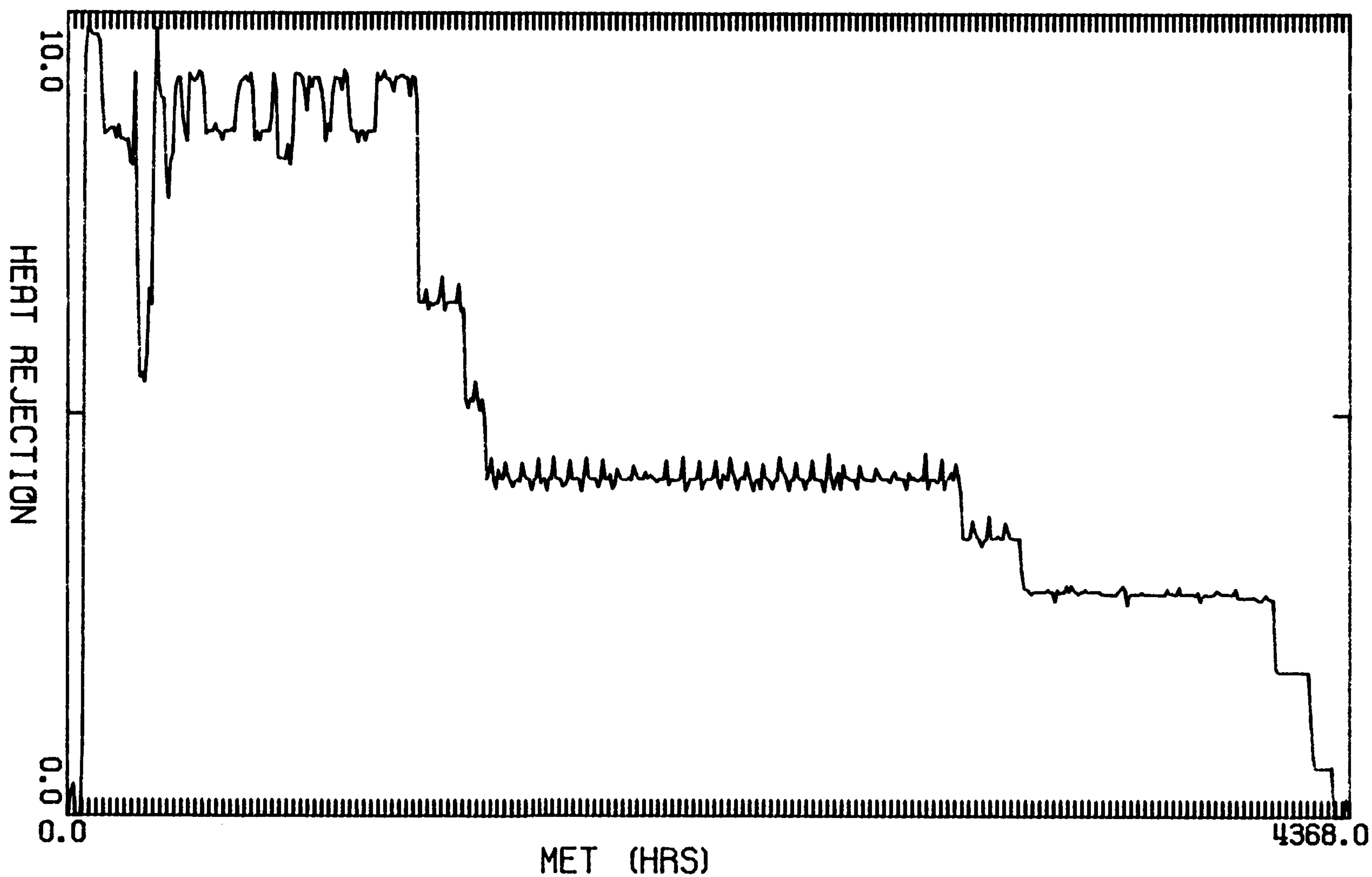
SCENARIO #20



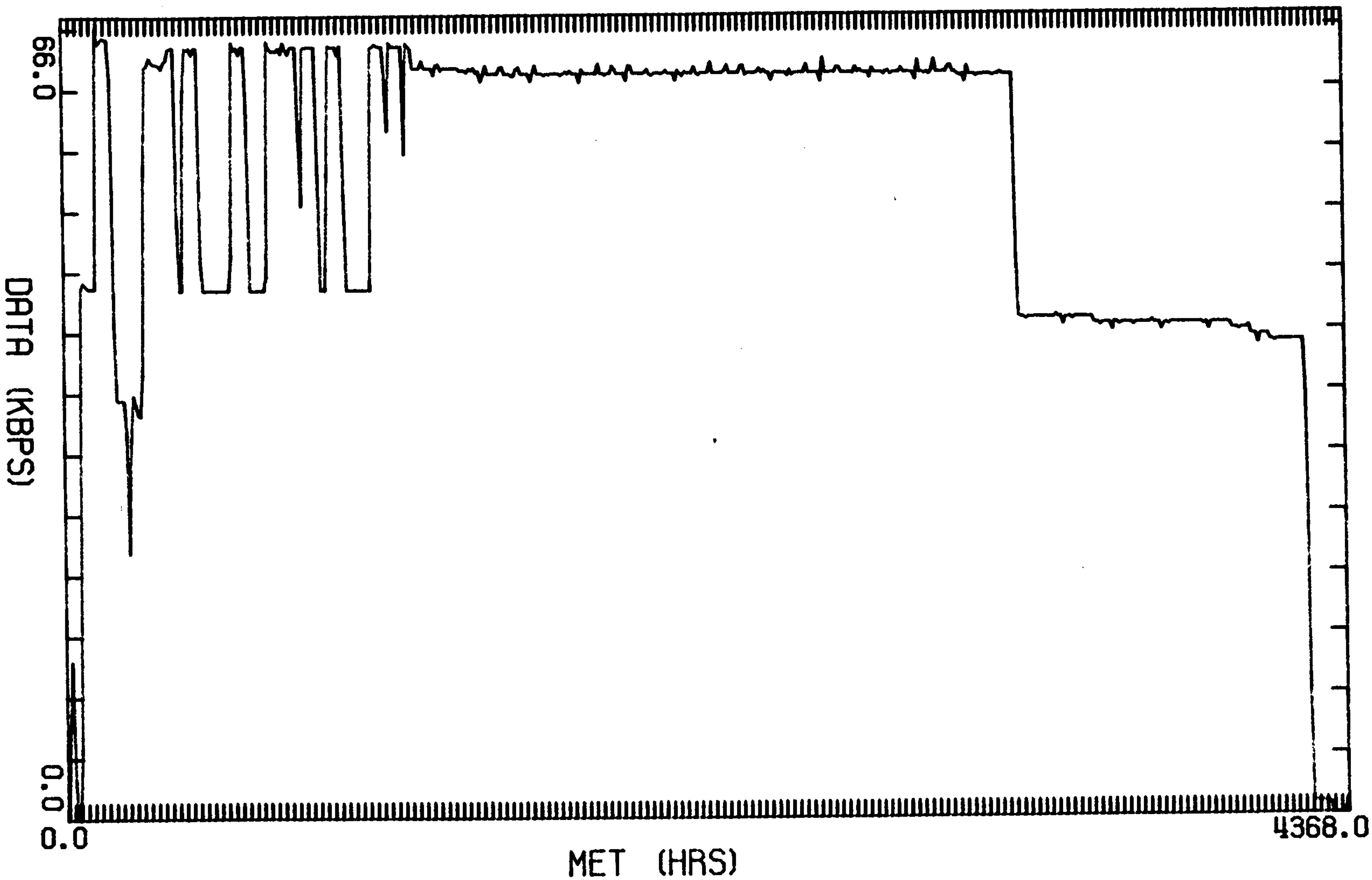
SCENARIO #20



SCENARIO #20



SCENARIO #20



DATA SUMMARY SHEET

Title: Scenario SF1

Available Panel Area: 7 DOUBLE RACKS 6 MOD. CONTAINERS

Peak Power: (10.3 kW limit) 9.80 kW actual

Total Energy Used: 13300.32 kW-hr

Average Power Usage: 4.542 kW

Peak Heat Rejection: 11.905 kW actual

Total Energy Rejected: 13305.3 kW-hr

Average Heat Rejection: 4.544 kW

Peak Data Rate: 14.369 kBits/sec

Average Data Rate: 2.266 kBits/sec

FACILITY	RUN LENGTH (hr)	NO. OF RUNS AVAILABLE IN 120 DAYS	NO. OF RUNS COMPLETED IN 120 DAYS	%EQUIPMENT UTILIZATION
Acoustic Levitator	49.86	36	19	53
Alloy Solidification	19.75	12	12	100
Bridgman, Small	675.60	10	3	33.3
Continuous Flow Electro.	27.72	1	1	100
EM Levitator	3.55	36	36	100
Electroepitaxy	246.6	1 ,	1	100
Fluids Physics	121.34	1	1	100
Float Zone	169.98	10	5	50
Isoelectric Foc. 1&2	10.28	2	2	100
Latex Reactor 1&2	117.78	2	2	100
Organic & Polymer Cry.	97.77	27	23	85.1
Protein Crystal 1&2	240.43	20	16	80
Vapor Crystal Growth Sys	680.53	4	3	75

DATA SUMMARY SHEET

Title: Scenario SF2

Available Panel Area: 7 DOUBLE RACKS 6 MOD. CONTAINERS

Peak Power: (10.3 kW limit) 9.921 kW actual

Total Energy Used: 17570.18 kW-hr

Average Power Usage: 4.023 kW

Peak Heat Rejection: 11.003 kW actual

Total Energy Rejected: 17576.55 kW-hr

Average Heat Rejection: 4.024 kW

Peak Data Rate: 12.320 kBits/sec

Average Data Rate: 1.892 kBits/sec

FACILITY	RUN LENGTH (hr)	NO. OF RUNS AVAILABLE IN 180 DAYS	NO. OF RUNS COMPLETED IN 180 DAYS	%EQUIPMENT UTILIZATION
Acoustic Levitator	49.86	36	24	66.7
Alloy Solidification	19.75	12	12	100
Bridgman, Small	675.60	10	5	50
Continuous Flow Electro.	27.72	1	1	100
EM Levitator	3.55	36	36	100
Electroepitaxy	246.6	1	1	100
Fluids Physics	121.34	1	1	100
Float Zone	169.98	10	7	70
Isoelectric Foc. 1&2	10.28	2	2	100
Latex Reactor 1&2	117.78	2	2	100
Organic & Polymer Cry.	97.77	27	27	100
Protein Crystal 1&2	240.43	20	20	100
Vapor Crystal Growth Sys	680.53	4	4	100

DATA SUMMARY SHEET

Title: Scenario SF3

Available Panel Area: 15 DOUBLE RACKS 14 MOD. CONTAINERS

Peak Power: (10.3 kW limit) 9.911 kW actual

Total Energy Used: 14159.51 kW-hr

Average Power Usage: 4.835 kW

Peak Heat Rejection: 12.589 kW actual

Total Energy Rejected: 14165.94 kW-hr

Average Heat Rejection: 4.838 kW

Peak Data Rate: 28.980 kBits/sec

Average Data Rate: 3.106 kBits/sec

FACILITY	RUN LENGTH (hr)	NO. OF RUNS AVAILABLE IN 120 DAYS	NO. OF RUNS COMPLETED IN 120 DAYS	%EQUIPMENT UTILIZATION
Acoustic Levitator 1&2	49.86	72	18	25
Alloy Solid. 1&2	19.75	24	16	66.7
Bridgman, Small 1&2	675.60	20	2	10
Continuous Flow 1&2	27.72	2	2	100
Critical Point Pheno.		1	1	100
EM Levitator 1&2	3.55	72	37	51.4
Electroepitaxy 1&2	246.6	2	2	100
Fluids Physics 1&2	121.34	2	2	100
Float Zone 1&2	169.98	20	5	25
Isoelectric Foc.1,2,3&4	10.28	4	4	100
Latex Reactor 1,2,3&4	117.78	4	4	100
Organic & Polymer 1,2&3	97.77	81	42	51.9
Protein Cry. 1,2,3&4	240.43	40	22	55
Vapor Crystal Gro. 1&2	680.53	8	2	25

DATA SUMMARY SHEET

Title: Scenario SF4

Available Panel Area: 15 DOUBLE RACKS 14 MOD. CONTAINERS

Peak Power: (10.3 kW limit) 10.300 kW actual

Total Energy Used: 20111.420 kW-hr

Average Power Usage: 4.604 kW

Peak Heat Rejection: 10.799 kW actual

Total Energy Rejected: 20118.78 kW-hr

Average Heat Rejection: 4.606 kW

Peak Data Rate: 29.560 kBits/sec

Average Data Rate: 3.205 kBits/sec

FACILITY	RUN LENGTH (hr)	NO. OF RUNS AVAILABLE IN 180 DAYS	NO. OF RUNS COMPLETED IN 180 DAYS	%EQUIPMENT UTILIZATION
Acoustic Levitator 1&2	49.86	72	18	25
Alloy Solid. 1&2	19.75	24	21	87.5
Bridgman, Small 1&2	675.60	20	3	15
Continuous Flow 1&2	27.72	2	2	100
Critical Point Pheno.		1	1	100
EM Levitator 1&2	3.55	72	57	79.2
Electroepitaxy 1&2	246.6	2	2	100
Fluids Physics 1&2	121.34	2	2	100
Float Zone 1&2	169.98	20	6	30
Isoelectric Foc.1,2,3&4	10.28	4	4	100
Latex Reactor 1,2,3&4	117.78	4	4	100
Organic & Polymer 1,2&3	97.77	81	70	86.4
Protein Cry. 1,2,3&4	240.43	40	37	92.5
Vapor Crystal Gro. 1&2	680.53	8	5	62.5

DATA SUMMARY SHEET

Title: Scenario SF5

Available Panel Area: 7 DOUBLE RACKS 6 MOD. CONTAINERS

Peak Power: (10.3 kW limit High Beta angle) 10.095 kW actual

Total Energy Used: 12341.85 kW-hr

Average Power Usage: 4.215 kW

Peak Heat Rejection: TBD kW actual

Total Energy Rejected: TBD kW-hr

Average Heat Rejection: TBD kW

Peak Data Rate: 13.22 kBits/sec

Average Data Rate: 2.243 TBD kBits/sec

FACILITY	RUN LENGTH (hr)	NO. OF RUNS AVAILABLE IN 120 DAYS	NO. OF RUNS COMPLETED IN 120 DAYS	%EQUIPMENT UTILIZATION
Acoustic Levitator	49.86	36	15	41.6
Alloy Solidification	19.75	12	12	100
Bridgman, Small	675.60	10	3	33.3
Continuous Flow Electro.	27.72	1	1	100
EM Levitator	3.55	36	36	100
Electroepitaxy	246.6	1	1	100
Fluids Physics	121.34	1	1	100
Float Zone	169.98	10	4	40
Isoelectric Foc. 1&2	10.28	2	2	100
Latex Reactor 1&2	117.78	2	2	100
Organic & Polymer Cry.	97.77	27	24	88.9
Protein Crystal 1&2	240.43	20	16	80
Vapor Crystal Growth Sys	680.53	4	3	75

DATA SUMMARY SHEET

Title: Scenario SF6

Available Panel Area: 7 DOUBLE RACKS 6 MOD. CONTAINERS

Peak Power: (10.3 kW limit Low Beta Angle) 9.800 kW actual

Total Energy Used: 18462.57 kW-hr

Average Power Usage: 4.227 kW

Peak Heat Rejection: 11.905 kW actual

Total Energy Rejected: 18469.00 kW-hr

Average Heat Rejection: 4.228 kW

Peak Data Rate: 14.396 kBits/sec

Average Data Rate: 1.913 kBits/sec

FACILITY	RUN LENGTH (hr)	NO. OF RUNS AVAILABLE IN 180 DAYS	NO. OF RUNS COMPLETED IN 180 DAYS	%EQUIPMENT UTILIZATION
Acoustic Levitator	49.86	36	23	63.9
Alloy Solidification	19.75	12	12	100
Bridgman, Small	675.60	10	5	50
Continuous Flow Electro.	27.72	1	1	100
EM Levitator	3.55	36	36	100
Electroepitaxy	246.6	1	1	100
Fluids Physics	121.34	1	1	100
Float Zone	169.98	10	9	90
Isoelectric Foc. 1&2	10.28	2	2	100
Latex Reactor 1&2	117.78	2	2	100
Organic & Polymer Cry.	97.77	27	27	100
Protein Crystal 1&2	240.43	20	20	100
Vapor Crystal Growth Sys	680.53	4	4	100

DATA SUMMARY SHEET

Title: Scenario SF7

Available Panel Area: 15 DOUBLE RACKS 14 MOD. CONTAINERS

Peak Power: (10.3 kW limit High Beta Angle) 9.813 kW actual

Total Energy Used: 13496.91 kW-hr

Average Power Usage: 4.610 kW

Peak Heat Rejection: 11.726 kW actual

Total Energy Rejected: 13502.14 kW-hr

Average Heat Rejection: 4.611 kW

Peak Data Rate: 30.860 kBits/sec

Average Data Rate: 2.88 kBits/sec

FACILITY	RUN LENGTH (hr)	NO. OF RUNS AVAILABLE IN 120 DAYS	NO. OF RUNS COMPLETED IN 120 DAYS	%EQUIPMENT UTILIZATION
Acoustic Levitator 1&2	49.86	72	17	23.6
Alloy Solid. 1&2	19.75	24	15	62.5
Bridgman, Small 1&2	675.60	20	3	15
Continuous Flow 1&2	27.72	2	2	100
Critical Point Pheno.	720.9	1	1	100
EM Levitator 1&2	3.55	72	37	51.4
Electroepitaxy 1&2	246.6	2	2	100
Fluids Physics 1&2	121.34	2	2	100
Float Zone 1&2	169.98	20	3	15
Isoelectric Foc.1,2,3&4	10.28	4	4	100
Latex Reactor 1,2,3&4	117.78	4	4	100
Organic & Polymer 1,2&3	97.77	81	41	50.6
Protein Cry. 1,2,3&4	240.43	40	20	50
Vapor Crystal Gro. 1&2	680.53	8	2	25

DATA SUMMARY SHEET

Title: Scenario SF8

Available Panel Area: 15 DOUBLE RACKS 14 MOD. CONTAINERS

Peak Power: (10.3 kW limit Low Beta Angle) 9.948 kW actual

Total Energy Used: 20195.46 kW-hr

Average Power Usage: 4.623 kW

Peak Heat Rejection: 11.489 kW actual

Total Energy Rejected: 20203.74 kW-hr

Average Heat Rejection: 4.625 kW

Peak Data Rate: 28.98 kBits/sec

Average Data Rate: 3.314 kBits/sec

FACILITY	RUN LENGTH (hr)	NO. OF RUNS AVAILABLE IN 180 DAYS	NO. OF RUNS COMPLETED IN 180 DAYS	%EQUIPMENT UTILIZATION
Acoustic Levitator 1&2	49.86	72	20	27.8
Alloy Solid. 1&2	19.75	24	16	66.7
Bridgman, Small 1&2	675.60	20	4	20
Continuous Flow 1&2	27.72	2	2	100
Critical Point Pheno.	720.9	1	1	100
EM Levitator 1&2	3.55	72	44	61.1
Electroepitaxy 1&2	246.6	2	2	100
Fluids Physics 1&2	121.34	2	2	100
Float Zone 1&2	169.98	20	3	15
Isoelectric Foc.1,2,3&4	10.28	4	4	100
Latex Reactor 1,2,3&4	117.78	4	4	100
Organic & Polymer 1,2&3	97.77	81	64	79
Protein Cry. 1,2,3&4	240.43	40	40	100
Vapor Crystal Gro. 1&2	680.53	8	6	75

DATA SUMMARY SHEET

Title: Scenario SF9

Available Panel Area: 7 DOUBLE RACKS 6 MOD. CONTAINERS

Peak Power: (11.0 kW limit) 10.35 kW actual

Total Energy Used: 19873.05 kW-hr

Average Power Usage: 6.787 kW

Peak Heat Rejection: 13.377 kW actual

Total Energy Rejected: 19884.17 kW-hr

Average Heat Rejection: 6.791 kW

Peak Data Rate: 12.536 kBits/sec

Average Data Rate: 2.883 kBits/sec

FACILITY	RUN LENGTH (hr)	NO. OF RUNS AVAILABLE IN 120 DAYS	NO. OF RUNS COMPLETED IN 120 DAYS	%EQUIPMENT UTILIZATION
Acoustic Levitator	49.86	36	36	100
Alloy Solidification	19.75	12	12	100
Bridgman, Small	675.60	10	4	40
Continuous Flow Electro.	27.72	1	1	100
EM Levitator	3.55	36	36	100
Electroepitaxy	246.6	1	1	100
Fluids Physics	121.34	1	1	100
Float Zone	169.98	10	10	100
Isoelectric Foc. 1&2	10.28	2	2	100
Latex Reactor 1&2	117.78	2	2	100
Organic & Polymer Cry.	97.77	27	27	100
Protein Crystal 1&2	240.43	20	20	100
Vapor Crystal Growth Sys	680.53	4	4	100

DATA SUMMARY SHEET

Title: Scenario SF10

Available Panel Area: 7 DOUBLE RACKS 6 MOD. CONTAINERS

Peak Power: (11.0 kW limit) 10.35 kW actual

Total Energy Used: 21221.73 kW-hr

Average Power Usage: 4.858 kW

Peak Heat Rejection: 13.377 kW actual

Total Energy Rejected: 21232.81 kW-hr

Average Heat Rejection: 4.861 kW

Peak Data Rate: 12.536 kBits/sec

Average Data Rate: 1.988 kBits/sec

FACILITY	RUN LENGTH (hr)	NO. OF RUNS AVAILABLE IN 120 DAYS	NO. OF RUNS COMPLETED IN 120 DAYS	%EQUIPMENT UTILIZATION
Acoustic Levitator	49.86	36	36	100
Alloy Solidification	19.75	12	12	100
Bridgman, Small	675.60	10	5	60
Continuous Flow Electro.	27.72	1	1	100
EM Levitator	3.55	36	36	100
Electroepitaxy	246.6	1	1	100
Fluids Physics	121.34	1	1	100
Float Zone	169.98	10	10	100
Isoelectric Foc. 1&2	10.28	2	2	100
Latex Reactor 1&2	117.78	2	2	100
Organic & Polymer Cry.	97.77	27	27	100
Protein Crystal 1&2	240.43	20	20	100
Vapor Crystal Growth Sys	680.53	4	4	100

ITEM /PARAMETER	SCENARIO NUMBER					
	1			2		
PEAK POWER	11.288			11.262		
ENERGY IN	7718.9			8851.7		
AVERAGE POWER	2.6802			2.049		
PEAK THERMAL	11.686			12.504		
ENERGY OUT	7648.4			8758		
AVERAGE THERMAL	2.6557			2.0273		
PEAK DATA RATE	64.2			57.6		
AVERAGE DATA RATE	16.73			16.19		
DURATION (DAYS)	120			180		
PANEL AREA (RACK/MIDDECK)	7DOUBLE/24MIDDECK			7DOUBLE/24MIDDECK		
ARRAYS BETA ANGLE	LOW			HIGH		
EXPERIMENTS / FACILITIES	1 MAX	1 ACT.	1%	2 MAX	2 ACT	2%
3AAL	2	2	100	2	2	100
AADSF	1	1	100	1	1	100
CVT	2	2	100	2	2	100
DMOS	1	1	100	1	1	100
ECG	6	6	100	6	6	100
EML	6	6	100	6	6	100
FES	1	1	100	1	1	100
FZCGF	1	1	100	1	1	100
HAL	0	0	0	0	0	0
MEPF	20	9	45	20	15	75
MWEU	1	1	100	1	1	100
NFF-1	1	1	100	1	1	100
OPCGF	1	1	100	1	1	100
PCG-IV	40	20	50	40	32	80
PVTOS	2	2	100	2	2	100
VCGS	1	1	100	1	1	100

ITEM /PARAMETER	SCENARIO NUMBER					
	3			4		
PEAK POWER	11.173			11.022		
ENERGY IN	11762			16040		
AVERAGE POWER	4.0839			3.7131		
PEAK THERMAL	12.902			14.618		
ENERGY OUT	11585			15856		
AVERAGE THERMAL	4.0224			3.6703		
PEAK DATA RATE	65.2			66.3		
AVERAGE DATA RATE	24.31			24.58		
DURATION (DAYS)	120			180		
PANEL AREA (RACK/MIDDECK)	15DOUBLE/52MIDDECK			15DOUBLE/52MIDDECK		
ARRAYS BETA ANGLE	LOW			HIGH		
EXPERIMENTS / FACILITIES	3 MAX	3 ACT	3%	4 MAX	4 ACT	4%
3AAL	2	1	50	2	1	50
AADSF	2	2	100	2	2	100
CVT	6	6	100	6	6	100
DMOS	3	3	100	3	3	100
ECG	12	7	58.333	12	11	91.667
EML	12	12	100	12	12	100
FES	2	2	100	2	2	100
FZCGF	3	3	100	3	3	100
HAL	20	17	85	20	17	85
MEPF	20	7	35	20	13	65
MWEU	3	3	100	3	3	100
NFF-1	2	2	100	2	2	100
OPCGF	3	3	100	3	3	100
PCG-IV	60	32	53.333	60	55	91.667
PVTOS	4	4	100	4	4	100
VCGS	2	2	100	2	2	100

ITEM /PARAMETER	SCENARIO NUMBER					
	5			6		
PEAK POWER	11.262			11.288		
ENERGY IN	7718.9			8851.7		
AVERAGE POWER	2.6802			2.049		
PEAK THERMAL	12.504			11.686		
ENERGY OUT	7649.2			8755.1		
AVERAGE THERMAL	2.656			2.0266		
PEAK DATA RATE	57.5			64.9		
AVERAGE DATA RATE	16.32			15.996		
DURATION (DAYS)	120			180		
PANEL AREA (RACK/MIDDECK)	7DOUBLE/24MIDDECK			7DOUBLE/24MIDDECK		
ARRAYS BETA ANGLE	HIGH			LOW		
EXPERIMENTS / FACILITIES	5 MAX	5 ACT	5%	6 MAX	6 ACT	6%
3AAL	2	2	100	2	2	100
AADSF	1	1	100	1	1	100
CVT	2	2	100	2	2	100
DMOS	1	1	100	1	1	100
ECG	6	6	100	6	6	100
EML	6	6	100	6	6	100
FES	1	1	100	1	1	100
FZCGF	1	1	100	1	1	100
HAL	0	0	0	0	0	0
MEPF	20	9	45	20	15	75
MWEU	1	1	100	1	1	100
NFF-1	1	1	100	1	1	100
OPCGF	1	1	100	1	1	100
PCG-IV	40	20	50	40	32	80
PVTOS	2	2	100	2	2	100
VCGS	1	1	100	1	1	100

ITEM /PARAMETER	SCENARIO NUMBER					
	7			8		
PEAK POWER	11.022			11.173		
ENERGY IN	13178			16736		
AVERAGE POWER	4.5758			3.8742		
PEAK THERMAL	14.618			12.902		
ENERGY OUT	13012			16551		
AVERAGE THERMAL	4.5181			3.8311		
PEAK DATA RATE	66.1			65.9		
AVERAGE DATA RATE	23.73			24.19		
DURATION (DAYS)	120			180		
PANEL AREA (RACK/MIDDECK)	15DOUBLE/52MIDDECK			15DOUBLE/52MIDDECK		
ARRAYS BETA ANGLE	HIGH			LOW		
EXPERIMENTS / FACILITIES	7 MAX	7 ACT	7%	8 MAX	8 ACT	8%
3AAL	2	1	50	2	1	50
AADSF	2	2	100	2	2	100
CVT	6	6	100	6	6	100
DMOS	3	3	100	3	3	100
ECG	12	9	75	12	12	100
EML	12	12	100	12	12	100
FES	2	2	100	2	2	100
FZCGF	3	3	100	3	3	100
HAL	20	17	85	20	17	85
MEPF	20	7	35	20	13	65
MWEU	3	3	100	3	3	100
NFF-1	2	2	100	2	2	100
OPCGF	3	3	100	3	3	100
PCG-IV	60	31	51.667	60	54	90
PVTOS	4	4	100	4	4	100
VCGS	2	2	100	2	2	100

ITEM /PARAMETER	SCENARIO NUMBER					
	9			10		
PEAK POWER	11.313			11.313		
ENERGY IN	8073			9347.6		
AVERAGE POWER	2.8031			2.1638		
PEAK THERMAL	11.554			11.554		
ENERGY OUT	7990.5			9257.4		
AVERAGE THERMAL	2.7745			2.1429		
PEAK DATA RATE	66.1			66.1		
AVERAGE DATA RATE	13.39			12.58		
DURATION (DAYS)	120			180		
PANEL AREA (RACK/MIDDECK)	7DOUBLE/24MIDDECK			7DOUBLE/24MIDDECK		
ARRAYS BETA ANGLE	CONSTANT			CONSTANT		
EXPERIMENTS / FACILITIES	9 MAX	9 ACT	9%	10 MAX	10 ACT	10%
3AAL	2	2	100	2	2	100
AADSF	1	1	100	1	1	100
CVT	2	2	100	2	2	100
DMOS	1	1	100	1	1	100
ECG	6	6	100	6	6	100
EML	6	6	100	6	6	100
FES	1	1	100	1	1	100
FZCGF	1	1	100	1	1	100
HAL	0	0	0	0	0	0
MEPF	20	11	55	20	18	90
MWEU	1	1	100	1	1	100
NFF-1	1	1	100	1	1	100
OPCGF	1	1	100	1	1	100
PCG-IV	40	23	57.5	40	35	87.5
PVTOS	2	2	100	2	2	100
VCGS	1	1	100	1	1	100

ITEM /PARAMETER	SCENARIO NUMBER					
	11			12		
PEAK POWER	11.557			11.568		
ENERGY IN	13434			19582		
AVERAGE POWER	4.6647			4.5329		
PEAK THERMAL	13.464			13.36		
ENERGY OUT	13528			19513		
AVERAGE THERMAL	4.6973			4.5168		
PEAK DATA RATE	67.2			67.2		
AVERAGE DATA RATE	38.12			44.288		
DURATION (DAYS)	120			180		
PANEL AREA (RACK/MIDDECK)	7DOUBLE/24MIDDECK			7DOUBLE/24MIDDECK		
ARRAYS BETA ANGLE	LOW			HIGH		
EXPERIMENTS / FACILITIES	11 MAX	11 ACT.	11%	12 MAX	12 ACT	12%
3AAL	16	2	12.5	16	2	12.5
AADSF	11	7	63.636	17	14	82.353
CVT	49	28	57.143	50	44	88
DMOS	16	13	81.25	20	20	100
ECG	6	6	100	6	6	100
EML	6	3	50	6	6	100
FES	50	14	28	50	25	50
FZCGF	15	15	100	15	15	100
HAL	0	0	0	0	0	0
MEPF	12	9	75	18	14	77.778
MWEU	2	2	100	2	2	100
NFF-1	18	10	55.556	27	20	74.074
OPCGF	14	10	71.429	20	18	90
PCG-IV	24	16	66.667	36	30	83.333
PVTOS	22	13	59.091	22	20	90.909
VCGS	17	12	70.588	26	21	80.769

ITEM /PARAMETER	SCENARIO NUMBER					
	13			14		
PEAK POWER	11.286			11.533		
ENERGY IN	14255			21581		
AVERAGE POWER	4.9496			4.9956		
PEAK THERMAL	13.314			13.854		
ENERGY OUT	14198			21562		
AVERAGE THERMAL	4.9299			4.9913		
PEAK DATA RATE	68.2			107.5		
AVERAGE DATA RATE	35.235			42.977		
DURATION (DAYS)	120			180		
PANEL AREA (RACK/MIDDECK)	15DOUBLE/52 MIDDECK			15DOUBLE/52 MIDDECK		
ARRAYS BETA ANGLE	LOW			HIGH		
EXPERIMENTS / FACILITIES	13 MAX	13 ACT	13%	14 MAX	14 ACT	14%
3AAL	16	16	100	16	16	100
AADSF	22	7	31.818	34	12	35.294
CVT	147	14	9.5238	150	49	32.667
DMOS	48	13	27.083	60	26	43.333
ECG	12	7	58.333	12	7	58.333
EML	12	4	33.333	12	8	66.667
FES	100	6	6	100	24	24
FZCGF	45	45	100	45	45	100
HAL	50	3	6	50	11	22
MEPF	16	5	31.25	18	12	66.667
MWEU	6	4	66.667	6	4	66.667
NFF-1	36	8	22.222	54	16	29.63
OPCGF	42	12	28.571	60	20	33.333
PCG-IV	72	18	25	72	34	47.222
PVTOS	44	16	36.364	44	27	61.364
VCGS	34	12	35.294	52	19	36.538

ITEM /PARAMETER	SCENARIO NUMBER					
	15			16		
PEAK POWER	11.598			11.598		
ENERGY IN	13835			19726		
AVERAGE POWER	4.8037			4.5663		
PEAK THERMAL	13.36			13.464		
ENERGY OUT	13439			19699		
AVERAGE THERMAL	4.6662			4.5599		
PEAK DATA RATE	67.2			67.2		
AVERAGE DATA RATE	39.218			44.611		
DURATION (DAYS)	120			180		
PANEL AREA (RACK/MIDDECK)	7DOUBLE/24 MIDDECKS			7DOUBLE/24 MIDDECKS		
ARRAYS BETA ANGLE	HIGH			LOW		
EXPERIMENTS / FACILITIES	15 MAX	15 ACT	15%	16 MAX	16 ACT	16%
3AAL	16	2	12.5	16	2	12.5
AADSF	11	8	72.727	17	13	76.471
CVT	49	24	48.98	50	50	100
DMOS	16	13	81.25	20	20	100
ECG	6	6	100	6	6	100
EML	6	6	100	6	6	100
FES	50	16	32	50	29	58
FZCGF	15	15	100	15	15	100
HAL	0	0	0	0	0	0
MEPF	12	8	66.667	18	15	83.333
MWEU	2	2	100	2	2	100
NFF-1	18	11	61.111	27	19	70.37
OPCGF	14	11	78.571	20	18	90
PCG-IV	24	18	75	36	29	80.556
PVTOS	22	13	59.091	22	21	95.455
VCGS	17	12	70.588	26	21	80.769

ITEM /PARAMETER	SCENARIO NUMBER 17	SCENARIO NUMBER 18
PEAK POWER	12.144	12.144
ENERGY IN	15308	22058
AVERAGE POWER	5.3152	5.106
PEAK THERMAL	14.618	13.314
ENERGY OUT	15379	22186
AVERAGE THERMAL	5.3399	5.1356
PEAK DATA RATE	95.5	86.9
AVERAGE DATA RATE	33.393	42.966
DURATION (DAYS)	120	180
PANEL AREA (RACK/MIDDECK)	15DOUBLE/52 MIDDECK	15DOUBLE/52 MIDDECK
ARRAYS BETA ANGLE	HIGH	LOW

EXPERIMENTS / FACILITIES	17 MAX	17 ACT	17%	18 MAX	18 ACT	18%
3AAL	16	16	100	16	16	100
AADSF	22	7	31.818	34	13	38.235
CVT	147	23	15.646	150	42	28
DMOS	48	13	27.083	60	22	36.667
ECG	12	7	58.333	12	7	58.333
EML	12	7	58.333	12	8	66.667
FES	100	15	15	100	23	23
FZCGF	45	45	100	45	45	100
HAL	50	11	22	50	22	44
MEPF	16	6	37.5	18	12	66.667
MWEU	6	4	66.667	6	4	66.667
NFF-1	36	7	19.444	54	17	31.481
OPCGF	42	11	26.19	60	20	33.333
PCG-IV	72	18	25	72	33	45.833
PVTOS	44	15	34.091	44	23	52.273
VCGS	34	8	23.529	52	20	38.462

ITEM /PARAMETER	SCENARIO NUMBER					
	19			20		
PEAK POWER	11.313			11.313		
ENERGY IN	18163			22989		
AVERAGE POWER	6.3065			5.3214		
PEAK THERMAL	12.486			12.486		
ENERGY OUT	18183			22919		
AVERAGE THERMAL	6.3134			5.3053		
PEAK DATA RATE	66.1			66.1		
AVERAGE DATA RATE	55.722			52.616		
DURATION (DAYS)	120			180		
PANEL AREA (RACK/MIDDECK)	7DOUBLE/24 MIDDECKS			7DOUBLE/24 MIDDECKS		
ARRAYS BETA ANGLE	CONSTANT			CONSTANT		
EXPERIMENTS / FACILITIES	19 MAX	19 ACT	19%	20 MAX	20 ACT	20%
3AAL	16	2	12.5	16	2	12.5
AADSF	11	11	100	17	16	94.118
CVT	49	47	95.918	50	50	100
DMOS	16	16	100	20	20	100
ECG	6	6	100	6	6	100
EML	6	6	100	6	6	100
FES	50	43	86	50	50	100
FZCGF	15	15	100	15	15	100
HAL	0	0	0	0	0	0
MEPF	12	11	91.667	18	18	100
MWEU	2	2	100	2	2	100
NFF-1	18	17	94.444	27	26	96.296
OPCGF	14	14	100	20	20	100
PCG-IV	24	23	95.833	36	35	97.222
PVTOS	22	15	68.182	22	21	95.455
VCGS	17	16	94.118	26	25	96.154

Consumables Based on Scenario SFI Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material

Consumables Based on Scenario SFI Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
high performance liquid chromatograph	acetonitrile	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
										0	0	0	0	0	0	0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
acoustic levitator	air	10	0.01312	0	0	100	1	19	19	0	0	0.24928	0	0	190		
alloy solidification	air	200	0.256	0	0	100	1	12	12	0	0	3.072	0	0	2400		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	3	3	0	0	0.168	0	0	135		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	1	1	0	0	0.00256	0	0	2		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	36	36	0	0	1.10592	0	0	864		
float zone	air	5	0.005973	0	0	100	1	5	5	0	0	0.029866	0	0	25		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	3	3	0	0	0.216045	0	0	168		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		4.843671	3784
acoustic levitator	Ar	41	0.052726	0	0	100	1	19	19	0	0	1.001794	0	0	779		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	3	3	0	0	0.233625	0	0	135		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	36	36	0	0	1.53792	0	0	864		
float zone	Ar	14	0.02492	0	0	100	1	5	5	0	0	0.1246	0	0	70		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	16	16	0	0	1.02528	0	0	576		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	3	3	0	0	0.1068	0	0	60		
													0	0		4.030019	2484
acoustic levitator	cleaning fluid	1	1	0	100	0	1	19	19	0	19	0	0	19	0		

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Consumables Based on Scenario SF1 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
alloy solidification	cleaning fluid	1	1	0	100	0	1	12	12	0	12	0	0	12	0		
atmospheric microphysics	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	100	0	1	3	3	0	1.5	0	0	1.5	0		
bulk crystal	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	100	0	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	100	0	1	36	36	0	0.36	0	0	0.36	0		
float zone	cleaning fluid	0.1	0.1	0	100	0	1	5	5	0	0.5	0	0	0.5	0		
fluid physics	cleaning fluid	0.1	0.1	0	100	0	1	0	0	0	0	0	0	0	0		
free float	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	100	0	1	23	23	0	0.23	0	0	0.23	0		
premixed gas combustion	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	100	0	1	3	3	0	0.03	0	0	0.03	0		
variable flow shell generator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		33.62	33.62
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
atmospheric microphysics	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	100	0	1	5	5	0	2.5	0	0	2.5	0		
fluid physics	deionized water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		
membrane production	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	100	0	1	23	23	0	23	0	0	23	0		
premixed gas combustion	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0.5	0.5	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	100	0	1	1	1	0	140	0	0	140	0		
isoelectric focusing	deion./depyro.	15	15	0	100	0	1	2	2	0	30	0	0	30	0		
protein crystal growth	deion./depyro.	0.7	0.7	0	100	0	1	16	16	0	11.2	0	0	11.2	0		
acoustic levitator	distilled water	1	1	0	100	0	1	19	19	0	19	0	0	19	0		
alloy solidification	distilled water	2	2	0	100	0	1	12	12	0	24	0	0	24	0		
autoclave	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	100	0	1	3	3	0	1.5	0	0	1.5	0		
bulk crystal	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		

Consumables Based on Scenario SFI Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
electrostatic levitator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	100	0	1	36	36	0	3.6	0	0	3.6	0		
free float	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	100	0	1	0	0	0	0	0	0	0	0		
variable flow shell generator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																256.8	256.8
electroepitaxy	GH2	250	0.0225	0	0	100	1	1	1	0	0	0.0225	0	0	250		
													0	0		0.0225	250
acoustic levitator	GHe	2	0.000355	0	0	100	1	19	19	0	0	0.006745	0	0	38		
alloy solidification	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.660225	9302
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	19	19	0.00038	0	0	0.00038	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	3	3	0.00006	0	0	0.00006	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	23	23	0.00046	0	0	0.00046	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	3	3	0.00006	0	0	0.00006	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.0013	0.0013
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

Consumables Based on Scenario SF1 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
premixed gas combustion	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	16	16	0	0	7.2	0	0	5760		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		7.8625	6290
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	16	16	0	0	0.82368	0	0	576		
solid surface burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0.82368	576
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0		
													0	0		0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.75	15
critical point phenomena	LHe	150	28.75	0	100	0	1	0	0	0	0	0	0	0	0		
													0	0		0	0
critical point phenomena	LN2	30	24.18	0	100	0	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	100	0	0	0	1	0	0	0	0	0	0		
gas chromatograph - mass spectrometer	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
high performance liquid chromatograph	methenol	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
cutting/polishing system	oil- water solu	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
water deionizer/depyrogenizer	process resin	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
solution crystal	solvents	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
													0	0		0.755	15.01
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	19	19	0.000077	0	0	0.000083	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000048	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000013	0	0		

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Consumables Based on Scenario SFI Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
float zone	wipes	0.000004	0.000004	100	0	0	1	5	5	0.000020	0	0	0.00002	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	23	23	0.000093	0	0	0.000101	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	16	16	0.000065	0	0	0.000070	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000013	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000350	0.000376
									Totals	1.506650	290.42	19.24259	30.01167	290.42	22686	311.1692	23006.43

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Samples Based on Scenario SF1

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
solid surface burning	fuel - solid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	burn catalytic	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel, liquid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	fuel - gaseous	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0		
isoelectric focusing	raw material	0.1	0.15	0	100	0	1	2	2	0	0.3	0	0	0.2	0		
organic & polymer crystal growth	buffer solution	34.4025	34.4025	0	100	0	1	23	23	0	791.2575	0	0	791.2575	0		
bioreactor/incubator	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	staining soluti	0.01	0.01	0	100	0	1	2	2	0	0.02	0	0	0.02	0		
continuous flow electrophoresis	raw material	0.3	0.4	0	100	0	1	1	1	0	0.4	0	0	0.3	0		
contact angle measurement unit	test fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	TGS solution	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	seed crystals	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
fluid physics	TGS solution	2	3.36	0	100	0	1	1	1	0	3.36	0	0	2	0		
protein crystal growth	reservior solut	0.00675	0.0135	0	100	0	1	16	16	0	0.216	0	0	0.108	0		
etching equipment	etchant solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
atmospheric microphysics	acid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	monomer/polymer	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
latex reactor	AMBN process in	0.25	0.2275	0	100	0	1	2	2	0	0.455	0	0	0.5	0		
latex reactor	styrene	0.75	0.6825	0	100	0	1	2	2	0	1.365	0	0	1.5	0		
continuous flow electrophoresis	staining soluti	0.01	0.01	0	100	0	1	1	1	0	0.01	0	0	0.01	0		
continuous flow electrophoresis	buffer solution	2.7	3.5	0	100	0	1	1	1	0	3.5	0	0	2.7	0		
isoelectric focusing	acid	0.3	0.375	0	100	0	1	2	2	0	0.75	0	0	0.6	0		
solution crystal	crystal solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	seed crystal	0.002	0.00164	0	100	0	1	1	1	0	0.00164	0	0	0.002	0		
rotating spherical convection	dielectric stud	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	protein solutio	0.02	0.02	0	100	0	1	16	16	0	0.32	0	0	0.32	0		
bulk crystal	liquid phase en	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	100	0	1	1	1	0	0.25	0	0	0.25	0		
bioreactor/incubator	raw material	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	disinfectant /	0.25	0.25	0	100	0	1	2	2	0	0.5	0	0	0.5	0		
isoelectric focusing	calibration sol	0.3	0.3	0	100	0	1	2	2	0	0.6	0	0	0.6	0		
protein crystal growth	disinfectants	0.001	0.001	0	100	0	1	16	16	0	0.016	0	0	0.016	0		
isoelectric focusing	amphoylte conce	0.15	0.3	0	100	0	1	2	2	0	0.6	0	0	0.3	0		
latex reactor	latex solutions	1	0.91	0	100	0	1	2	2	0	1.82	0	0	2	0		
membrane production	catalyst soluti	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	basic solution	0.3	0.435	0	100	0	1	2	2	0	0.87	0	0	0.6	0		
high performance liquid chromatograph	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																811.6111	808.7835
autoignition furnace	fuel sample - s	0	0	33.3	33.3	33.3	0	0	0	0	0	0	0	0	0		
																0	0
electroepitaxy	III-V group sou	2	11	50	50	0	1	1	1	5.5	5.5	0	1	1	0		
																11	2
free float	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	microcarrier be	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
float zone	raw material	0.1288	0.966	100	0	0	1	5	5	4.83	0	0	0.644	0	0		
organic & polymer crystal growth	acetonitrile	33.36	36.696	100	0	0	1	23	23	844.008	0	0	767.28	0	0		
acoustic levitator	raw material	0.1	0.6	100	0	0	1	19	19	11.4	0	0	1.9	0	0		
organic & polymer crystal growth	polydiacetylene	0.1288	0.2576	100	0	0	1	23	23	5.9248	0	0	2.9624	0	0		

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Samples Based on Scenario SF1

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
EM levitator	raw material	0.00177	0.033	100	0	0	1	36	36	1.188	0	0	0.06372	0	0		
optical fiber pulling	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
alloy solidification	raw material	0.66	4.93284	100	0	0	1	12	12	59.19408	0	0	7.92	0	0		
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0		
electrostatic levitator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	16	16	0.08	0	0	0.032	0	0		
cleaning equipment	solid waste	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, large	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bulk crystal	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	semiconductor o	0.2	1.8	100	0	0	1	3	3	5.4	0	0	0.6	0	0		
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	16	16	0.004	0	0	0.0056	0	0		
protein crystal growth	growth syringes	5	2	100	0	0	1	16	16	32	0	0	80	0	0		
water deionizer/depyrogenizer	filter cartridg	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	naphthalene	1.0425	1.0425	100	0	0	1	23	23	23.9775	0	0	23.9775	0	0		
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	sample material	0.315	2.523	100	0	0	1	3	3	7.569	0	0	0.945	0	0		
cutting/polishing system	encapsulant mat	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1001.575	890.3302
								Totals		1007.075	817.1111	0	891.3302	809.7835	0	1824.186	1701.113

Waste Requirements Based on Scenario SF1

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
high performance liquid chromatograph	acetonitrile	0	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
atmospheric microphysics	acid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
isoelectric focusing	acid	0.3	0.375	0	99	1	1	2	2	0	0.7425	0.0075	0	0.594	0.006	0.75	0.6
acoustic levitator	air	10	0.01312	0	0	100	1	19	19	0	0	0.24928	0	0	190		
alloy solidification	air	200	0.256	0	0	100	1	12	12	0	0	3.072	0	0	2400		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	3	3	0	0	0.168	0	0	135		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	1	1	0	0	0.00256	0	0	2		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	36	36	0	0	1.10592	0	0	864		
float zone	air	5	0.005973	0	0	100	1	5	5	0	0	0.029866	0	0	25		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	3	3	0	0	0.216045	0	0	168		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0	4.843671	3784
isoelectric focusing	ampholyte conce	0.15	0.3	0	99	1	1	2	2	0	0.594	0.006	0	0.297	0.003	0.6	0.3
bridgman, large	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	ampoule fragmen	0.001	0.0001	100	0	0	1	3	6	0.0006	0	0	0.006	0	0		
bulk crystal	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.0006	0.006
acoustic levitator	Ar	41	0.052726	0	0	100	1	19	19	0	0	1.001794	0	0	779		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	3	3	0	0	0.233625	0	0	135		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	36	36	0	0	1.53792	0	0	864		
float zone	Ar	14	0.02492	0	0	100	1	5	5	0	0	0.1246	0	0	70		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	16	16	0	0	1.02528	0	0	576		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	3	3	0	0	0.1068	0	0	60	4.030019	2484
isoelectric focusing	basic solution	0.3	0.435	0	99	1	1	2	2	0	0.8613	0.0087	0	0.594	0.006		

Waste Requirements Based on Scenario SF1

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
																0.87	0.6
UV sterilization unit	biological wast	0	0	89.98	10	0.01	0	0	0	0	0	0	0	0	0		
																0	0
cutting/polishing system	boule fragments	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	buffer solution	2.7	3.5	2	97.9	0.1	1	1	1	0.07	3.4265	0.0035	0.054	2.6433	0.0027		
																3.5	2.7
isoelectric focusing	calibration sol	0.3	0.3	0	99.9	0.1	1	2	2	0	0.5994	0.0006	0	0.5994	0.0006		
																0.6	0.6
membrane production	catalyst soluti	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																0	0
acoustic levitator	cleaning fluid	1	1	0	99	1	1	19	19	0	18.81	0.19	0	18.81	0.19		
alloy solidification	cleaning fluid	1	1	0	99	1	1	12	12	0	11.88	0.12	0	11.88	0.12		
atmospheric microphysics	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	99	1	1	3	3	0	1.485	0.015	0	1.485	0.015		
bulk crystal	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	99	1	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	99	1	1	36	36	0	0.3564	0.0036	0	0.3564	0.0036		
float zone	cleaning fluid	0.1	0.1	0	99	1	1	5	5	0	0.495	0.005	0	0.495	0.005		
fluid physics	cleaning fluid	0.1	0.1	0	99	1	1	1	1	0	0.099	0.001	0	0.099	0.001		
free float	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	99	1	1	23	23	0	0.2277	0.0023	0	0.2277	0.0023		
premixed gas combustion	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	99	1	1	3	3	0	0.0297	0.0003	0	0.0297	0.0003		
variable flow shell generator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																33.72	33.72
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
autoignition furnace	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
droplet/spray burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
premixed gas combustion	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
solid surface burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
																0	0
critical point phenomena	cryogen	0	0	0	0	64560	1	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0		
																5	5
atmospheric microphysics	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF1

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
autoignition furnace	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	99.9	0.1	1	5	5	0	2.4975	0.0025	0	2.4975	0.0025		
fluid physics	deionized water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
membrane production	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	99.9	0.1	1	23	23	0	22.977	0.023	0	22.977	0.023		
premixed gas combustion	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0	0	0	99.9	0.1	1	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	99.9	0.1	1	1	1	0	139.86	0.14	0	139.86	0.14		
isoelectric focusing	deion./depyro.	15	15	0	99.9	0.1	1	2	2	0	29.97	0.03	0	29.97	0.03		
protein crystal growth	deion./depyro.	0.7	0.7	0	99.9	0.1	1	16	16	0	11.1888	0.0112	0	11.1888	0.0112		
acoustic levitator	distilled water	1	1	0	99.9	0.1	1	19	19	0	18.981	0.019	0	18.981	0.019		
alloy solidification	distilled water	2	2	0	99.9	0.1	1	12	12	0	23.976	0.024	0	23.976	0.024		
autoclave	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	99.9	0.1	1	3	3	0	1.4985	0.0015	0	1.4985	0.0015		
bulk crystal	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
electrostatic levitator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	99.9	0.1	1	36	36	0	3.5964	0.0036	0	3.5964	0.0036		
free float	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	99.9	0.1	1	3	3	0	1.4985	0.0015	0	1.4985	0.0015		
variable flow shell generator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																258.3	258.3
rotating spherical convection	dielectric stud	0	0	0	99.99	0.01	0	0	0	0	0	0	0	0	0		
																0	0
isoelectric focusing	disinfectant /	0.25	0.25	0	99	1	1	2	2	0	0.495	0.005	0	0.495	0.005		
bioreactor/incubator	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	99	1	1	1	1	0	0.2475	0.0025	0	0.2475	0.0025		
high performance liquid chromatograph	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
protein crystal growth	disinfectants	0.001	0.001	0	99	1	1	16	16	0	0.01584	0.00016	0	0.01584	0.00016		
																0.766	0.766
solid surface burning	fuel	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
premixed gas	fuel	0	0	0	0	10	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0		
autoignition furnace	fuel	0	0	0.333	0.333	0.333	0	0	0	0	0	0	0	0	0		
																0	0
alloy solidificaton	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
acoustic levitator	GHe	2	0.000355	0	0	100	1	19	19	0	0	0.006745	0	0	38		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

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Waste Requirements Based on Scenario SF1

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																1.660225	9302
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	19	19	0.00038	0	0	0.00038	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	3	3	0.00006	0	0	0.00006	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	23	23	0.00046	0	0	0.00046	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	3	3	0.00006	0	0	0.00006	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.0013	0.0013
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	16	16	0	0	7.2	0	0	5760		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																7.8625	6290
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	16	16	0	0	0.82368	0	0	576		
																0.82368	576
protein crystal growth	growth syringes	5	2	100	0	0	1	16	16	32	0	0	80	0	0		
																32	80
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	16	16	0.004	0	0	0.0056	0	0		
																0.004	0.0056
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0		
																0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.75	15
critical point phenomena	LHe	150	15.489	0	0	69940	1	0	0	0	0	0	0	0	0		
																0	0
critical point phenomena	LN2	30	24.18	0	0	64560	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	0	64560	0	0	1	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF1

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
gas chromatograph - mass spectrometer	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0	0	0
high performance liquid chromatograph	methonol	0	0	0	90	10	0	0	0	0	0	0	0	0	0	0	0
bioreactor/incubator	microcarrier be	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
cutting/polishing system	oil- water solu	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
water deionizer/depyrogenizer	process resin	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
protein crystal growth	protein solutio	0.02	0.02	0	99	1	1	16	16	0	0.3168	0.0032	0	0.3168	0.0032	0.32	0.32
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	16	16	0.08	0	0	0.032	0	0	0.08	0.032
cutting/polishing system	raw material	0	0	99	0	1	0	0	0	0	0	0	0	0	0	0	0
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0	6	4
protein crystal growth	reservior solut	0.00675	0.0135	0	99	1	1	16	16	0	0.21384	0.00216	0	0.10692	0.00108	0.216	0.108
general purpose hand tools	residual gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
cleaning equipment	solid waste	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0	0	0
solution crystal	solvents	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	staining soluti	0.01	0.01	0	99	1	1	1	1	0	0.0099	0.0001	0	0.0099	0.0001		
isoelectric focusing	staining soluti	0.01	0.01	0	99	1	1	2	2	0	0.0198	0.0002	0	0.0198	0.0002	0.03	0.03
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.755	15.01
solution crystal	TGS solution	0	0	0.1	49.8	0.1	1	0	0	0	0	0	0	0	0	0	0
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	19	19	0.000077	0	0	0.000083	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000048	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000013	0	0		
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		

Waste Requirements Based on Scenario SF1

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili- zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
float zone	wipes	0.000004	0.000004	100	0	0	1	5	5	0.000020	0	0	0.000022	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	23	23	0.000093	0	0	0.000101	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	16	16	0.000065	0	0	0.000070	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000013	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000350	0.000378
								Totals		39.66125	303.9668	19.85521	114.1092	302.3639	22436.62	363.4833	22853.09

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Consumables Based on Scenario SF2 Mission

Consumables Based on Scenario SF2 Mission

Facility/ Equipment | Material | Volume per run liters | mass kilogram | % solid | % liq | % gas | equip utiliz-ation | run per facility | runs per mission | solid mass kg | liquid mass kg | gas mass kg | solid volume liter | liquid volume liter | gas volume liter | total mass for material | total volume fo material

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
high performance liquid chromatograph	acetonitrile	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
										0	0	0	0	0	0	0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
acoustic levitator	air	10	0.01312	0	0	100	1	24	24	0	0	0.31488	0	0	240		
alloy solidification	air	200	0.256	0	0	100	1	12	12	0	0	3.072	0	0	2400		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	5	5	0	0	0.28	0	0	225		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	1	1	0	0	0.00256	0	0	2		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	36	36	0	0	1.10592	0	0	864		
float zone	air	5	0.005973	0	0	100	1	7	7	0	0	0.041813	0	0	35		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	4	4	0	0	0.28806	0	0	224		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		5.105233	3990
acoustic levitator	Ar	41	0.052726	0	0	100	1	24	24	0	0	1.265424	0	0	984		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	5	5	0	0	0.389375	0	0	225		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	36	36	0	0	1.53792	0	0	864		
float zone	Ar	14	0.02492	0	0	100	1	7	7	0	0	0.17444	0	0	98		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	20	20	0	0	1.2816	0	0	720		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	4	4	0	0	0.1424	0	0	80		
													0	0		4.791159	2971
acoustic levitator	cleaning fluid	1	1	0	100	0	1	24	24	0	24	0	0	24	0		

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Consumables Based on Scenario SF2 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
alloy solidification	cleaning fluid	1	1	0	100	0	1	12	12	0	12	0	0	12	0		
atmospheric microphysics	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	100	0	1	5	5	0	2.5	0	0	2.5	0		
bulk crystal	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	100	0	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
FM levitator	cleaning fluid	0.01	0.01	0	100	0	1	36	36	0	0.36	0	0	0.36	0		
float zone	cleaning fluid	0.1	0.1	0	100	0	1	7	7	0	0.7	0	0	0.7	0		
fluid physics	cleaning fluid	0.1	0.1	0	100	0	1	0	0	0	0	0	0	0	0		
free float	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	100	0	1	27	27	0	0.27	0	0	0.27	0		
premixed gas combustion	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	100	0	1	4	4	0	0.04	0	0	0.04	0		
variable flow shell generator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		39.87	39.87
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
atmospheric microphysics	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	100	0	1	7	7	0	3.5	0	0	3.5	0		
fluid physics	deionized water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		
membrane production	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	100	0	1	27	27	0	27	0	0	27	0		
premixed gas combustion	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0.5	0.5	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	100	0	1	1	1	0	140	0	0	140	0		
isoelectric focusing	deion./depyro.	15	15	0	100	0	1	2	2	0	30	0	0	30	0		
protein crystal growth	deion./depyro.	0.7	0.7	0	100	0	1	20	20	0	14	0	0	14	0		
acoustic levitator	distilled water	1	1	0	100	0	1	24	24	0	24	0	0	24	0		
alloy solidification	distilled water	2	2	0	100	0	1	12	12	0	24	0	0	24	0		
autoclave	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	100	0	1	5	5	0	2.5	0	0	2.5	0		
bulk crystal	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		

Consumables Based on Scenario SF2 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
electrostatic levitator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
FM levitator	distilled water	0.1	0.1	0	100	0	1	36	36	0	3.6	0	0	3.6	0		
free float	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	100	0	1	0	0	0	0	0	0	0	0		
variable flow shell generator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																270.6	270.6
electroepitaxy	GH2	250	0.0225	0	0	100	1	1	1	0	0	0.0225	0	0	250		
													0	0		0.0225	250
acoustic levitator	GHe	2	0.000555	0	0	100	1	24	24	0	0	0.00852	0	0	48		
alloy solidification	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
FM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.662	9312
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	24	24	0.00048	0	0	0.00048	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	5	5	0.0001	0	0	0.0001	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	27	27	0.00054	0	0	0.00054	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.00154	0.00154
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

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Consumables Based on Scenario SF2 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
premixed gas combustion	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	20	20	0	0	9	0	0	7200		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		9.6625	7730
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	20	20	0	0	1.0296	0	0	720		
solid surface burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.0296	720
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0		
													0	0		0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.75	15
critical point phenomena	LHe	150	28.75	0	100	0	1	0	0	0	0	0	0	0	0		
													0	0		0	0
critical point phenomena	LN2	30	24.18	0	100	0	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	100	0	0	0	1	0	0	0	0	0	0		
gas chromatograph - mass spectrometer	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
high performance liquid chromatograph	methanol	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
cutting/polishing system	oil- water solu	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
water deionizer/depyrogenizer	process resin	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
solution crystal	solvents	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
													0	0		0.755	15.01
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	24	24	0.000097	0	0	0.000105	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000048	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	5	5	0.000020	0	0	0.000022	0	0		

Consumables Based on Scenario SF2 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
float zone	wipes	0.000004	0.000004	100	0	0	1	7	7	0.000028	0	0	0.000028	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	27	27	0.000110	0	0	0.000118	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000424	0.000454
									Totals	1.506964	310.47	22.27299	30.01199	310.47	24973	334.2499	25313.48

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Samples Based on Scenario SF2

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili- zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
solid surface burning	fuel - solid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	burn catalytic	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel, liquid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	fuel - gaseous	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0		
isoelectric focusing	raw material	0.1	0.15	0	100	0	1	2	2	0	0.3	0	0	0.2	0		
organic & polymer crystal growth	buffer solution	34.4025	34.4025	0	100	0	1	27	27	0	928.8675	0	0	928.8675	0		
bioreactor/incubator	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	staining soluti	0.01	0.01	0	100	0	1	2	2	0	0.02	0	0	0.02	0		
continuous flow electrophoresis	raw material	0.3	0.4	0	100	0	1	1	1	0	0.4	0	0	0.3	0		
contact angle measurement unit	test fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	TGS solution	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	seed crystals	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
fluid physics	TGS solution	2	3.36	0	100	0	1	1	1	0	3.36	0	0	2	0		
protein crystal growth	reservior solut	0.00675	0.0135	0	100	0	1	20	20	0	0.27	0	0	0.135	0		
etching equipment	etchant solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
atmospheric microphysics	acid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	monomer/polymer	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
latex reactor	AMBN process in	0.25	0.2275	0	100	0	1	2	2	0	0.455	0	0	0.5	0		
latex reactor	styrene	0.75	0.6825	0	100	0	1	2	2	0	1.365	0	0	1.5	0		
continuous flow electrophoresis	staining soluti	0.01	0.01	0	100	0	1	1	1	0	0.01	0	0	0.01	0		
continuous flow electrophoresis	buffer solution	2.7	3.5	0	100	0	1	1	1	0	3.5	0	0	2.7	0		
isoelectric focusing	acid	0.3	0.375	0	100	0	1	2	2	0	0.75	0	0	0.6	0		
solution crystal	crystal solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	seed crystal	0.002	0.00164	0	100	0	1	1	1	0	0.00164	0	0	0.002	0		
rotating spherical convection	dielectric stud	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	protein solutio	0.02	0.02	0	100	0	1	20	20	0	0.4	0	0	0.4	0		
bulk crystal	liquid phase en	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	100	0	1	1	1	0	0.25	0	0	0.25	0		
bioreactor/incubator	raw material	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	disinfectant /	0.25	0.25	0	100	0	1	2	2	0	0.5	0	0	0.5	0		
isoelectric focusing	calibration sol	0.3	0.3	0	100	0	1	2	2	0	0.6	0	0	0.6	0		
protein crystal growth	disinfectants	0.001	0.001	0	100	0	1	20	20	0	0.02	0	0	0.02	0		
isoelectric focusing	amphoylte conce	0.15	0.3	0	100	0	1	2	2	0	0.6	0	0	0.3	0		
latex reactor	latex solutions	1	0.91	0	100	0	1	2	2	0	1.82	0	0	2	0		
membrane production	catalyst soluti	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	basic solution	0.3	0.435	0	100	0	1	2	2	0	0.87	0	0	0.6	0		
high performance liquid chromatograph	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																949.3591	946.5045
autoignition furnace	fuel sample - s	0	0	33.3	33.3	33.3	0	0	0	0	0	0	0	0	0		
																0	0
electroepitaxy	III-V group sou	2	11	50	50	0	1	1	1	5.5	5.5	0	1	1	0		
																11	2
free float	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	microcarrier be	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
float zone	raw material	0.1288	0.966	100	0	0	1	7	7	6.762	0	0	0.9016	0	0		
organic & polymer crystal growth	acetonitrile	33.36	36.696	100	0	0	1	27	27	990.792	0	0	900.72	0	0		
acoustic levitator	raw material	0.1	0.6	100	0	0	1	24	24	14.4	0	0	2.4	0	0		
organic & polymer crystal growth	polydiacetylene	0.1288	0.2576	100	0	0	1	27	27	6.9552	0	0	3.4776	0	0		

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Samples Based on Scenario SF2

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
EM levitator	raw material	0.00177	0.033	100	0	0	1	36	36	1.188	0	0	0.06372	0	0		
optical fiber pulling	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
alloy solidification	raw material	0.66	4.93284	100	0	0	1	12	12	59.19408	0	0	7.92	0	0		
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0		
electrostatic levitator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	20	20	0.1	0	0	0.04	0	0		
cleaning equipment	solid waste	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, large	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bulk crystal	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	semiconductor o	0.2	1.8	100	0	0	1	4	4	7.2	0	0	0.8	0	0		
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	20	20	0.005	0	0	0.007	0	0		
protein crystal growth	growth syringes	5	2	100	0	0	1	20	20	40	0	0	100	0	0		
water deionizer/depyrogenizer	filter cartridg	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	naphthalene	1.0425	1.0425	100	0	0	1	27	27	28.1475	0	0	28.1475	0	0		
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	sample material	0.315	2.523	100	0	0	1	5	5	12.615	0	0	1.575	0	0		
cutting/polishing system	encapsulant mat	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1173.358	1050.052
								Totals		1178.858	954.8591	0	1051.052	947.5045	0	2133.717	1998.556

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Waste Requirements Based on Scenario SF2

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
high performance liquid chromatograph	acetonitrile	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
atmospheric microphysics	acid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
isoelectric focusing	acid	0.3	0.375	0	99	1	1	2	2	0	0.7425	0.0075	0	0.594	0.006		
																0.75	0.6
acoustic levitator	air	10	0.01312	0	0	100	1	24	24	0	0	0.31488	0	0	240		
alloy solidification	air	200	0.256	0	0	100	1	12	12	0	0	3.072	0	0	2400		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	5	5	0	0	0.28	0	0	225		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	1	1	0	0	0.00256	0	0	2		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	36	36	0	0	1.10592	0	0	864		
float zone	air	5	0.005973	0	0	100	1	7	7	0	0	0.041813	0	0	35		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	4	4	0	0	0.28806	0	0	224		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																5.105233	3990
isoelectric focusing	amphoylte conce	0.15	0.3	0	99	1	1	2	2	0	0.594	0.006	0	0.297	0.003		
																0.6	0.3
bridgman, large	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	ampoule fragmen	0.001	0.0001	100	0	0	1	5	6	0.0006	0	0	0.006	0	0		
bulk crystal	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.0006	0.006
acoustic levitator	Ar	41	0.052726	0	0	100	1	24	24	0	0	1.265424	0	0	984		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	5	5	0	0	0.389375	0	0	225		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	36	36	0	0	1.53792	0	0	864		
float zone	Ar	14	0.02492	0	0	100	1	7	7	0	0	0.17444	0	0	98		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	20	20	0	0	1.2816	0	0	720		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	4	4	0	0	0.1424	0	0	80		
																4.791159	2971
isoelectric focusing	basic solution	0.3	0.435	0	99	1	1	2	2	0	0.8613	0.0087	0	0.594	0.006		

Waste Requirements Based on Scenario SF2

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
																0.87	0.6
UV sterilization unit	biological wast	0	0	89.98	10	0.01	0	0	0	0	0	0	0	0	0		
																0	0
cutting/polishing system	boule fragments	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	buffer solution	2.7	3.5	2	97.9	0.1	1	1	1	0.07	3.4265	0.0035	0.054	2.6433	0.0027		
																3.5	2.7
isoelectric focusing	calibration sol	0.3	0.3	0	99.9	0.1	1	2	2	0	0.5994	0.0006	0	0.5994	0.0006		
																0.6	0.6
membrane production	catalyst soluti	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																0	0
acoustic levitator	cleaning fluid	1	1	0	99	1	1	24	24	0	23.76	0.24	0	23.76	0.24		
alloy solidification	cleaning fluid	1	1	0	99	1	1	12	12	0	11.88	0.12	0	11.88	0.12		
atmospheric microphysics	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	99	1	1	5	5	0	2.475	0.025	0	2.475	0.025		
bulk crystal	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	99	1	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	99	1	1	36	36	0	0.3564	0.0036	0	0.3564	0.0036		
float zone	cleaning fluid	0.1	0.1	0	99	1	1	7	7	0	0.693	0.007	0	0.693	0.007		
fluid physics	cleaning fluid	0.1	0.1	0	99	1	1	1	1	0	0.099	0.001	0	0.099	0.001		
free float	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	99	1	1	27	27	0	0.2673	0.0027	0	0.2673	0.0027		
premixed gas combustion	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	99	1	1	4	4	0	0.0396	0.0004	0	0.0396	0.0004		
variable flow shell generator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																39.97	39.97
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
autoignition furnace	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
droplet/spray burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
premixed gas combustion	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
solid surface burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
																0	0
critical point phenomena	cryogen	0	0	0	0	64560	1	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0		
																5	5
atmospheric microphysics	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF2

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
autoignition furnace	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	99.9	0.1	1	7	7	0	3.4965	0.0035	0	3.4965	0.0035		
fluid physics	deionized water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
membrane production	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	99.9	0.1	1	27	27	0	26.973	0.027	0	26.973	0.027		
premixed gas combustion	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0	0	0	99.9	0.1	1	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	99.9	0.1	1	1	1	0	139.86	0.14	0	139.86	0.14		
isoelectric focusing	deion./depyro.	15	15	0	99.9	0.1	1	2	2	0	29.97	0.03	0	29.97	0.03		
protein crystal growth	deion./depyro.	0.7	0.7	0	99.9	0.1	1	20	20	0	13.986	0.014	0	13.986	0.014		
acoustic levitator	distilled water	1	1	0	99.9	0.1	1	24	24	0	23.976	0.024	0	23.976	0.024		
alloy solidification	distilled water	2	2	0	99.9	0.1	1	12	12	0	23.976	0.024	0	23.976	0.024		
autoclave	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	99.9	0.1	1	5	5	0	2.4975	0.0025	0	2.4975	0.0025		
bulk crystal	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
electrostatic levitator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	99.9	0.1	1	36	36	0	3.5964	0.0036	0	3.5964	0.0036		
free float	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	99.9	0.1	1	4	4	0	1.998	0.002	0	1.998	0.002		
variable flow shell generator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																272.6	272.6
rotating spherical convection	dielectric stud	0	0	0	99.99	0.01	0	0	0	0	0	0	0	0	0		
																0	0
isoelectric focusing	disinfectant /	0.25	0.25	0	99	1	1	2	2	0	0.495	0.005	0	0.495	0.005		
bioreactor/incubator	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	99	1	1	1	1	0	0.2475	0.0025	0	0.2475	0.0025		
high performance liquid chromatograph	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
protein crystal growth	disinfectants	0.001	0.001	0	99	1	1	20	20	0	0.0198	0.0002	0	0.0198	0.0002		
																0.77	0.77
solid surface burning	fuel	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
premixed gas	fuel	0	0	0	0	10	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0		
autoignition furnace	fuel	0	0	0.333	0.333	0.333	0	0	0	0	0	0	0	0	0		
																0	0
alloy solidificaton	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
acoustic levitator	GHe	2	0.000355	0	0	100	1	24	24	0	0	0.00852	0	0	48		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF2

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																1.662	9312
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	24	24	0.00048	0	0	0.00048	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	5	5	0.0001	0	0	0.0001	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	27	27	0.00054	0	0	0.00054	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.00154	0.00154
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	20	20	0	0	9	0	0	7200		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																9.6625	7730
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	20	20	0	0	1.0296	0	0	720		
																1.0296	720
protein crystal growth	growth syringes	5	2	100	0	0	1	20	20	40	0	0	100	0	0		
																40	100
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	20	20	0.005	0	0	0.007	0	0		
																0.005	0.007
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0		
																0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.75	15
critical point phenomena	LHe	150	15.489	0	0	69940	1	0	0	0	0	0	0	0	0		
																0	0
critical point phenomena	LN2	30	24.18	0	0	64560	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	0	64560	0	0	1	0	0	0	0	0	0		

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Waste Requirements Based on Scenario SF2

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
gas chromatograph - mass spectrometer	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0	0	0
high performance liquid chromatograph	methonol	0	0	0	90	10	0	0	0	0	0	0	0	0	0	0	0
bioreactor/incubator	microcarrier be	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
cutting/polishing system	oil- water solu	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
water deionizer/depyrogenizer	process resin	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
protein crystal growth	protein solutio	0.02	0.02	0	99	1	1	20	20	0	0.396	0.004	0	0.396	0.004	0.4	0.4
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	20	20	0.1	0	0	0.04	0	0	0.1	0.04
cutting/polishing system	raw material	0	0	99	0	1	0	0	0	0	0	0	0	0	0	0	0
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0	6	4
protein crystal growth	reservior solut	0.00675	0.0135	0	99	1	1	20	20	0	0.2673	0.0027	0	0.13365	0.00135	0.27	0.135
general purpose hand tools	residual gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
cleaning equipment	solid waste	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0	0	0
solution crystal	solvents	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	staining soluti	0.01	0.01	0	99	1	1	1	1	0	0.0099	0.0001	0	0.0099	0.0001		
isoelectric focusing	staining soluti	0.01	0.01	0	99	1	1	2	2	0	0.0198	0.0002	0	0.0198	0.0002	0.03	0.03
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.755	15.01
solution crystal	TGS solution	0	0	0.1	49.8	0.1	1	0	0	0	0	0	0	0	0	0	0
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	24	24	0.000097	0	0	0.000105	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000048	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	5	5	0.000020	0	0	0.000022	0	0		
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		

Waste Requirements Based on Scenario SF2

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
float zone	wipes	0.000004	0.000004	100	0	0	1	7	7	0.000028	0	0	0.000030	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	27	27	0.000110	0	0	0.000118	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000424	0.000457
								Totals		47.68256	324.5767	22.96379	134.1189	322.9470	24723.70	395.2230	25180.76

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Consumables Based on Scenario SF3 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material

Consumables Based on Scenario SF3 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
high performance liquid chromatograph	acetonitrile	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
										0	0	0	0	0	0	0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
acoustic levitator	air	10	0.01312	0	0	100	1	18	18	0	0	0.23616	0	0	180		
alloy solidification	air	200	0.256	0	0	100	1	16	16	0	0	4.096	0	0	3200		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	2	2	0	0	0.112	0	0	90		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	2	2	0	0	0.00512	0	0	4		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	37	37	0	0	1.13664	0	0	888		
float zone	air	5	0.005973	0	0	100	1	5	5	0	0	0.029866	0	0	25		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	2	2	0	0	0.14403	0	0	112		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		5.759816 -	4499
acoustic levitator	Ar	41	0.052726	0	0	100	1	18	18	0	0	0.949068	0	0	738		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	2	2	0	0	0.15575	0	0	90		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	37	37	0	0	1.58064	0	0	888		
float zone	Ar	14	0.02492	0	0	100	1	5	5	0	0	0.1246	0	0	70		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	22	22	0	0	1.40976	0	0	792		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	2	2	0	0	0.0712	0	0	40		
													0	0		4.291018	2618
acoustic levitator	cleaning fluid	1	1	0	100	0	1	18	18	0	18	0	0	18	0		

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Consumables Based on Scenario SF3 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
alloy solidification	cleaning fluid	1	1	0	100	0	1	16	16	0	16	0	0	16	0		
atmospheric microphysics	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	100	0	1	2	2	0	1	0	0	1	0		
bulk crystal	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	100	0	1	1	1	0	1	0	0	1	0		
droplet/spray burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	100	0	1	37	37	0	0.37	0	0	0.37	0		
float zone	cleaning fluid	0.1	0.1	0	100	0	1	5	5	0	0.5	0	0	0.5	0		
fluid physics	cleaning fluid	0.1	0.1	0	100	0	1	0	0	0	0	0	0	0	0		
free float	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	100	0	1	42	42	0	0.42	0	0	0.42	0		
premixed gas combustion	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	100	0	1	2	2	0	0.02	0	0	0.02	0		
variable flow shell generator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		37.31	37.31
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
atmospheric microphysics	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	100	0	1	5	5	0	2.5	0	0	2.5	0		
fluid physics	deionized water	1	1	0	100	0	1	2	2	0	2	0	0	2	0		
membrane production	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	100	0	1	42	42	0	42	0	0	42	0		
premixed gas combustion	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0.5	0.5	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	100	0	1	2	2	0	280	0	0	280	0		
isoelectric focusing	deion./depyro.	15	15	0	100	0	1	4	4	0	60	0	0	60	0		
protein crystal growth	deion./depyro.	0.7	0.7	0	100	0	1	22	22	0	15.4	0	0	15.4	0		
acoustic levitator	distilled water	1	1	0	100	0	1	18	18	0	18	0	0	18	0		
alloy solidification	distilled water	2	2	0	100	0	1	16	16	0	32	0	0	32	0		
autoclave	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	100	0	1	2	2	0	1	0	0	1	0		
bulk crystal	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	100	0	1	2	2	0	2	0	0	2	0		

Consumables Based on Scenario SF3 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
electrostatic levitator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	100	0	1	37	37	0	3.7	0	0	3.7	0		
free float	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	100	0	1	0	0	0	0	0	0	0	0		
variable flow shell generator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																458.6	458.6
electroepitaxy	GH2	250	0.0225	0	0	100	1	2	2	0	0	0.045	0	0	500		
													0	0		0.045	500
acoustic levitator	GHe	2	0.000355	0	0	100	1	18	18	0	0	0.00639	0	0	36		
alloy solidification	GHe	700	0.12495	0	0	100	1	16	16	0	0	1.9992	0	0	11200		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	1	1	0	0	0.0357	0	0	200		
droplet/spray burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	37	37	0	0	0.15836	0	0	888		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		2.19965	12324
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	18	18	0.00036	0	0	0.00036	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	16	16	0.00032	0	0	0.00032	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	42	42	0.00084	0	0	0.00084	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.0018	0.0018
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	1	1	0	0	0.25	0	0	200		
droplet/spray burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	2	2	0	0	1.25	0	0	1000		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	2	2	0	0	0.075	0	0	60		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

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Consumables Based on Scenario SF3 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
premixed gas combustion	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	22	22	0	0	9.9	0	0	7920		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		11.475	9180
atmospheric microphysics	G02	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	G02	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	G02	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	G02	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	G02	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	G02	36	0.05148	0	0	100	1	22	22	0	0	1.13256	0	0	792		
solid surface burning	G02	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.13256	792
alloy solidification	inert gas	0	0	0	0	100	1	16	16	0	0	0	0	0	0		
													0	0		0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	2	2	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		1.5	30
critical point phenomena	LHe	150	28.75	0	100	0	1	1	1	0	28.75	0	0	150	0		
													0	0		28.75	150
critical point phenomena	LN2	30	24.18	0	100	0	1	1	1	0	24.18	0	0	30	0		
freezer	LN2	0	0	0	100	0	0	0	1	0	0	0	0	0	0		
gas chromatograph - mass spectrometer	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		24.18	30
high performance liquid chromatograph	methenol	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
cutting/polishing system	oil- water solu	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
water deionizer/depyrogenizer	process resin	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
solution crystal	solvents	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	2	2	0.01	0	0	0.02	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
solution crystal	test tubes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
													0	0		1.51	30.02
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	18	18	0.000073	0	0	0.000079	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	16	16	0.000065	0	0	0.000070	0	0		
autoignition furnace	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		

Consumables Based on Scenario SF3 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
float zone	wipes	0.000004	0.000004	100	0	0	1	5	5	0.000020	0	0	0.00002	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	42	42	0.000171	0	0	0.000184	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	22	22	0.000089	0	0	0.000096	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000481	0.000517
									Totals	3.012281	548.84	24.90304	60.02231	675.91	29913	576.7553	30648.93

Samples Based on Scenario SF3

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
solid surface burning	fuel - solid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	burn catalytic	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel, liquid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	fuel - gaseous	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	2	2	0	10	0	0	10	0		
isoelectric focusing	raw material	0.1	0.15	0	100	0	1	4	4	0	0.6	0	0	0.4	0		
organic & polymer crystal growth	buffer solution	34.4025	34.4025	0	100	0	1	42	42	0	1444.905	0	0	1444.905	0		
bioreactor/incubator	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	staining soluti	0.01	0.01	0	100	0	1	4	4	0	0.04	0	0	0.04	0		
continuous flow electrophoresis	raw material	0.3	0.4	0	100	0	1	2	2	0	0.8	0	0	0.6	0		
contact angle measurement unit	test fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	TGS solution	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	seed crystals	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
fluid physics	TGS solution	2	3.36	0	100	0	1	2	2	0	6.72	0	0	4	0		
protein crystal growth	reservior solut	0.00675	0.0135	0	100	0	1	22	22	0	0.297	0	0	0.1485	0		
etching equipment	etchant solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
atmospheric microphysics	acid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	monomer/polymer	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
latex reactor	AMBN process in	0.25	0.2275	0	100	0	1	4	4	0	0.91	0	0	1	0		
latex reactor	styrene	0.75	0.6825	0	100	0	1	4	4	0	2.73	0	0	3	0		
continuous flow electrophoresis	staining soluti	0.01	0.01	0	100	0	1	2	2	0	0.02	0	0	0.02	0		
continuous flow electrophoresis	buffer solution	2.7	3.5	0	100	0	1	2	2	0	7	0	0	5.4	0		
isoelectric focusing	acid	0.3	0.375	0	100	0	1	4	4	0	1.5	0	0	1.2	0		
solution crystal	crystal solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	seed crystal	0.002	0.00164	0	100	0	1	2	2	0	0.00328	0	0	0.004	0		
rotating spherical convection	dielectric stud	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	protein solutio	0.02	0.02	0	100	0	1	22	22	0	0.44	0	0	0.44	0		
bulk crystal	liquid phase en	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	100	0	1	2	2	0	0.5	0	0	0.5	0		
bioreactor/incubator	raw material	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	disinfectant /	0.25	0.25	0	100	0	1	4	4	0	1	0	0	1	0		
isoelectric focusing	calibration sol	0.3	0.3	0	100	0	1	4	4	0	1.2	0	0	1.2	0		
protein crystal growth	disinfectants	0.001	0.001	0	100	0	1	22	22	0	0.022	0	0	0.022	0		
isoelectric focusing	amphoylte conce	0.15	0.3	0	100	0	1	4	4	0	1.2	0	0	0.6	0		
latex reactor	latex solutions	1	0.91	0	100	0	1	4	4	0	3.64	0	0	4	0		
membrane production	catalyst soluti	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	basic solution	0.3	0.435	0	100	0	1	4	4	0	1.74	0	0	1.2	0		
high performance liquid chromatograph	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																1485.267	1479.679
autoignition furnace	fuel sample - s	0	0	33.3	33.3	33.3	0	0	0	0	0	0	0	0	0		
																0	0
electroepitaxy	III-V group sou	2	11	50	50	0	1	2	2	11	11	0	2	2	0		
																22	4
free float	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	microcarrier be	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
float zone	raw material	0.1288	0.966	100	0	0	1	5	5	4.83	0	0	0.644	0	0		
organic & polymer crystal growth	acetonitrile	33.36	36.696	100	0	0	1	42	42	1541.232	0	0	1401.12	0	0		
acoustic levitator	raw material	0.1	0.6	100	0	0	1	18	18	10.8	0	0	1.8	0	0		
organic & polymer crystal growth	polydiacetylene	0.1288	0.2576	100	0	0	1	42	42	10.8192	0	0	5.4096	0	0		

Samples Based on Scenario SF3

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
EM levitator	raw material	0.00177	0.033	100	0	0	1	37	37	1.221	0	0	0.06549	0	0		
optical fiber pulling	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
alloy solidification	raw material	0.66	4.93284	100	0	0	1	16	16	78.92544	0	0	10.56	0	0		
latex reactor	reactors	2	3	100	0	0	1	4	4	12	0	0	8	0	0		
electrostatic levitator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	22	22	0.11	0	0	0.044	0	0		
cleaning equipment	solid waste	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, large	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bulk crystal	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	semiconductor o	0.2	1.8	100	0	0	1	2	2	3.6	0	0	0.4	0	0		
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	22	22	0.0055	0	0	0.0077	0	0		
protein crystal growth	growth syringes	5	2	100	0	0	1	22	22	44	0	0	110	0	0		
water deionizer/depyrogenizer	filter cartridg	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	naphthalene	1.0425	1.0425	100	0	0	1	42	42	43.785	0	0	43.785	0	0		
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	sample material	0.315	2.523	100	0	0	1	2	2	5.046	0	0	0.63	0	0		
cutting/polishing system	encapsulant mat	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1756.374	1582.465
								Totals		1767.374	1496.267	0	1584.465	1481.679	0	3263.641	3066.145

Waste Requirements Based on Scenario SF3

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
high performance liquid chromatograph	acetonitrile	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
atmospheric microphysics	acid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
isoelectric focusing	acid	0.3	0.375	0	99	1	1	4	4	0	1.485	0.015	0	1.188	0.012		
																1.5	1.2
acoustic levitator	air	10	0.01312	0	0	100	1	18	18	0	0	0.23616	0	0	180		
alloy solidification	air	200	0.256	0	0	100	1	16	16	0	0	4.096	0	0	3200		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	2	2	0	0	0.112	0	0	90		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	2	2	0	0	0.00512	0	0	4		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	37	37	0	0	1.13664	0	0	888		
float zone	air	5	0.005973	0	0	100	1	5	5	0	0	0.029866	0	0	25		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	2	2	0	0	0.14403	0	0	112		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																5.759816	4499
isoelectric focusing	amphoylte conce	0.15	0.3	0	99	1	1	4	4	0	1.188	0.012	0	0.594	0.006		
																1.2	0.6
bridgman, large	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	ampoule fragmen	0.001	0.0001	100	0	0	1	2	6	0.0006	0	0	0.006	0	0		
bulk crystal	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.0006	0.006
acoustic levitator	Ar	41	0.052726	0	0	100	1	18	18	0	0	0.949068	0	0	738		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	2	2	0	0	0.15575	0	0	90		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	37	37	0	0	1.58064	0	0	888		
float zone	Ar	14	0.02492	0	0	100	1	5	5	0	0	0.1246	0	0	70		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	22	22	0	0	1.40976	0	0	792		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	2	2	0	0	0.0712	0	0	40		
																4.291018	2618
isoelectric focusing	basic solution	0.3	0.435	0	99	1	1	4	4	0	1.7226	0.0174	0	1.188	0.012		

Waste Requirements Based on Scenario SF3

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
																1.74	1.2
UV sterilization unit	biological wast	0	0	89.98	10	0.01	0	0	0	0	0	0	0	0	0		
																0	0
cutting/polishing system	boule fragments	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	buffer solution	2.7	3.5	2	97.9	0.1	1	2	2	0.14	6.853	0.007	0.108	5.2866	0.0054		
																7	5.4
isoelectric focusing	calibration sol	0.3	0.3	0	99.9	0.1	1	4	4	0	1.1988	0.0012	0	1.1988	0.0012		
																1.2	1.2
membrane production	catalyst soluti	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																0	0
acoustic levitator	cleaning fluid	1	1	0	99	1	1	18	18	0	17.82	0.18	0	17.82	0.18		
alloy solidification	cleaning fluid	1	1	0	99	1	1	16	16	0	15.84	0.16	0	15.84	0.16		
atmospheric microphysics	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	99	1	1	2	2	0	0.99	0.01	0	0.99	0.01		
bulk crystal	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	99	1	1	1	1	0	0.99	0.01	0	0.99	0.01		
droplet/spray burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	99	1	1	37	37	0	0.3663	0.0037	0	0.3663	0.0037		
float zone	cleaning fluid	0.1	0.1	0	99	1	1	5	5	0	0.495	0.005	0	0.495	0.005		
fluid physics	cleaning fluid	0.1	0.1	0	99	1	1	2	2	0	0.198	0.002	0	0.198	0.002		
free float	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	99	1	1	42	42	0	0.4158	0.0042	0	0.4158	0.0042		
premixed gas combustion	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	99	1	1	2	2	0	0.0198	0.0002	0	0.0198	0.0002		
variable flow shell generator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																37.51	37.51
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
autoignition furnace	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
droplet/spray burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
premixed gas combustion	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
solid surface burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
																0	0
critical point phenomena	cryogen	0	0	0	0	64560	1	1	1	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	2	2	0	10	0	0	10	0		
																10	10
atmospheric microphysics	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF3

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
autoignition furnace	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	99.9	0.1	1	5	5	0	2.4975	0.0025	0	2.4975	0.0025		
fluid physics	deionized water	1	1	0	99.9	0.1	1	2	2	0	1.998	0.002	0	1.998	0.002		
membrane production	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	99.9	0.1	1	42	42	0	41.958	0.042	0	41.958	0.042		
premixed gas combustion	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0	0	0	99.9	0.1	1	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	99.9	0.1	1	2	2	0	279.72	0.28	0	279.72	0.28		
isoelectric focusing	deion./depyro.	15	15	0	99.9	0.1	1	4	4	0	59.94	0.06	0	59.94	0.06		
protein crystal growth	deion./depyro.	0.7	0.7	0	99.9	0.1	1	22	22	0	15.3846	0.0154	0	15.3846	0.0154		
acoustic levitator	distilled water	1	1	0	99.9	0.1	1	18	18	0	17.982	0.018	0	17.982	0.018		
alloy solidification	distilled water	2	2	0	99.9	0.1	1	16	16	0	31.968	0.032	0	31.968	0.032		
autoclave	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	99.9	0.1	1	2	2	0	0.999	0.001	0	0.999	0.001		
bulk crystal	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	99.9	0.1	1	2	2	0	1.998	0.002	0	1.998	0.002		
electrostatic levitator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	99.9	0.1	1	37	37	0	3.6963	0.0037	0	3.6963	0.0037		
free float	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	99.9	0.1	1	2	2	0	0.999	0.001	0	0.999	0.001		
variable flow shell generator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																459.6	459.6
rotating spherical convection	dielectric stud	0	0	0	99.99	0.01	0	0	0	0	0	0	0	0	0		
																0	0
isoelectric focusing	disinfectant /	0.25	0.25	0	99	1	1	4	4	0	0.99	0.01	0	0.99	0.01		
bioreactor/incubator	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	99	1	1	2	2	0	0.495	0.005	0	0.495	0.005		
high performance liquid chromatograph	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
protein crystal growth	disinfectants	0.001	0.001	0	99	1	1	22	22	0	0.02178	0.00022	0	0.02178	0.00022		
																1.522	1.522
solid surface burning	fuel	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
premixed gas	fuel	0	0	0	0	10	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0		
autoignition furnace	fuel	0	0	0.333	0.333	0.333	0	0	0	0	0	0	0	0	0		
																0	0
alloy solidificaton	GHe	700	0.12495	0	0	100	1	16	16	0	0	1.9992	0	0	11200		
acoustic levitator	GHe	2	0.000355	0	0	100	1	18	18	0	0	0.00639	0	0	36		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	1	1	0	0	0.0357	0	0	200		
EM levitator	GHe	24	0.00428	0	0	100	1	37	37	0	0	0.15836	0	0	888		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

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Waste Requirements Based on Scenario SF3

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili- zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																2.19965	12324
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	18	18	0.00036	0	0	0.00036	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	16	16	0.00032	0	0	0.00032	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	42	42	0.00084	0	0	0.00084	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.0018	0.0018
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	1	1	0	0	0.25	0	0	200		
electroepitaxy	GN2	500	0.625	0	0	100	1	2	2	0	0	1.25	0	0	1000		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	2	2	0	0	0.075	0	0	60		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	22	22	0	0	9.9	0	0	7920		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																11.475	9180
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	22	22	0	0	1.13256	0	0	792		
																1.13256	792
protein crystal growth	growth syringes	5	2	100	0	0	1	22	22	44	0	0	110	0	0		
																44	110
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	22	22	0.0055	0	0	0.0077	0	0		
																0.0055	0.0077
alloy solidification	inert gas	0	0	0	0	100	1	16	16	0	0	0	0	0	0		
																0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	2	2	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1.5	30
critical point phenomena	LHe	150	15.489	0	0	69940	1	1	1	0	0	15.489	0	0	104910		
																15.489	104910
critical point phenomena	LN2	30	24.18	0	0	64560	1	1	1	0	0	24.18	0	0	19368		
freezer	LN2	0	0	0	0	64560	0	0	1	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF3

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
gas chromatograph - mass spectrometer	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0	24.18	19368
high performance liquid chromatograph	methonol	0	0	0	90	10	0	0	0	0	0	0	0	0	0	0	0
bioreactor/incubator	microcarrier be	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
cutting/polishing system	oil- water solu	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
water deionizer/depyrogenizer	process resin	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
protein crystal growth	protein solutio	0.02	0.02	0	99	1	1	22	22	0	0.4356	0.0044	0	0.4356	0.0044	0.44	0.44
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	22	22	0.11	0	0	0.044	0	0	0.11	0.044
cutting/polishing system	raw material	0	0	99	0	1	0	0	0	0	0	0	0	0	0	0	0
latex reactor	reactors	2	3	100	0	0	1	4	4	12	0	0	8	0	0	12	8
protein crystal growth	reservior solut	0.00675	0.0135	0	99	1	1	22	22	0	0.29403	0.00297	0	0.147015	0.001485	0.297	0.1485
general purpose hand tools	residual gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
cleaning equipment	solid waste	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0	0	0
solution crystal	solvents	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	staining soluti	0.01	0.01	0	99	1	1	2	2	0	0.0198	0.0002	0	0.0198	0.0002		
isoelectric focusing	staining soluti	0.01	0.01	0	99	1	1	4	4	0	0.0396	0.0004	0	0.0396	0.0004	0.06	0.06
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	2	2	0.01	0	0	0.02	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
solution crystal	test tubes	0	0	100	0	0	0	0	0	0	0	0	0	0	0	1.51	30.02
solution crystal	TGS solution	0	0	0.1	49.8	0.1	1	0	0	0	0	0	0	0	0	0	0
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	18	18	0.000073	0	0	0.000079	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	16	16	0.000065	0	0	0.000070	0	0		
autoignition furnace	wipes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		

Waste Requirements Based on Scenario SF3

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
float zone	wipes	0.000004	0.000004	100	0	0	1	5	5	0.000020	0	0	0.000022	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	42	42	0.000171	0	0	0.000184	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	22	22	0.000089	0	0	0.000096	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000481	0.000519
								Totals		59.26838	521.0185	65.43753	178.1880	517.8794	153691.8	645.7244	154387.9

Consumables Based on Scenario SF4 Mission

Consumables Based on Scenario SF4 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
high performance liquid chromatograph	acetonitrile	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
										0	0	0	0	0	0	0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
acoustic levitator	air	10	0.01312	0	0	100	1	18	18	0	0	0.23616	0	0	180		
alloy solidification	air	200	0.256	0	0	100	1	21	21	0	0	5.376	0	0	4200		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	3	3	0	0	0.168	0	0	135		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	2	2	0	0	0.00512	0	0	4		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
FM levitator	air	24	0.03072	0	0	100	1	57	57	0	0	1.75104	0	0	1368		
float zone	air	5	0.005973	0	0	100	1	6	6	0	0	0.03584	0	0	30		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	5	5	0	0	0.360075	0	0	280		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		7.932235	6197
acoustic levitator	Ar	41	0.052726	0	0	100	1	18	18	0	0	0.949068	0	0	738		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	3	3	0	0	0.233625	0	0	135		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	57	57	0	0	2.43504	0	0	1368		
float zone	Ar	14	0.02492	0	0	100	1	6	6	0	0	0.14952	0	0	84		
gas chromatograph mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	37	37	0	0	2.37096	0	0	1332		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	5	5	0	0	0.178	0	0	100		
													0	0		6.316213	3757
acoustic levitator	cleaning fluid	1	1	0	100	0	1	18	18	0	18	0	0	18	0		

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Consumables Based on Scenario SF4 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
alloy solidification	cleaning fluid	1	1	0	100	0	1	21	21	0	21	0	0	21	0		
atmospheric microphysics	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	100	0	1	3	3	0	1.5	0	0	1.5	0		
bulk crystal	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	100	0	1	1	1	0	1	0	0	1	0		
droplet/spray burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	100	0	1	57	57	0	0.57	0	0	0.57	0		
float zone	cleaning fluid	0.1	0.1	0	100	0	1	6	6	0	0.6	0	0	0.6	0		
fluid physics	cleaning fluid	0.1	0.1	0	100	0	1	0	0	0	0	0	0	0	0		
free float	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	100	0	1	70	70	0	0.7	0	0	0.7	0		
premixed gas combustion	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	100	0	1	5	5	0	0.05	0	0	0.05	0		
variable flow shell generator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		43.42	43.42
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
atmospheric microphysics	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	100	0	1	6	6	0	3	0	0	3	0		
fluid physics	deionized water	1	1	0	100	0	1	2	2	0	2	0	0	2	0		
membrane production	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	100	0	1	70	70	0	70	0	0	70	0		
premixed gas combustion	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0.5	0.5	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	100	0	1	2	2	0	280	0	0	280	0		
isoelectric focusing	deion./depyro.	15	15	0	100	0	1	4	4	0	60	0	0	60	0		
protein crystal growth	deion./depyro.	0.7	0.7	0	100	0	1	37	37	0	25.9	0	0	25.9	0		
acoustic levitator	distilled water	1	1	0	100	0	1	18	18	0	18	0	0	18	0		
alloy solidification	distilled water	2	2	0	100	0	1	21	21	0	42	0	0	42	0		
autoclave	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	100	0	1	3	3	0	1.5	0	0	1.5	0		
bulk crystal	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	100	0	1	2	2	0	2	0	0	2	0		

Consumables Based on Scenario SF4 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
electrostatic levitator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	100	0	1	57	57	0	5.7	0	0	5.7	0		
free float	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	100	0	1	0	0	0	0	0	0	0	0		
variable flow shell generator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																510.1	510.1
electroepitaxy	GH2	250	0.0225	0	0	100	1	2	2	0	0	0.045	0	0	500		
													0	0		0.045	500
acoustic levitator	GHe	2	0.000355	0	0	100	1	18	18	0	0	0.00639	0	0	36		
alloy solidification	GHe	700	0.12495	0	0	100	1	21	21	0	0	2.62395	0	0	14700		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	1	1	0	0	0.0357	0	0	200		
droplet/spray burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	57	57	0	0	0.24396	0	0	1368		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		2.91	16304
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	18	18	0.00036	0	0	0.00036	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	21	21	0.00042	0	0	0.00042	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	3	3	0.00006	0	0	0.00006	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	70	70	0.0014	0	0	0.0014	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	5	5	0.0001	0	0	0.0001	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.00254	0.00254
atmospheric mirrophysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	1	1	0	0	0.25	0	0	200		
droplet/spray burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	2	2	0	0	1.25	0	0	1000		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	2	2	0	0	0.075	0	0	60		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

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Consumables Based on Scenario SF4 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
premixed gas combustion	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	37	37	0	0	16.65	0	0	13320		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		18.225	14580
atmospheric microphysics	G02	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	G02	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	G02	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	G02	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	G02	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	G02	36	0.05148	0	0	100	1	37	37	0	0	1.90476	0	0	1332		
solid surface burning	G02	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.90476	1332
alloy solidification	inert gas	0	0	0	0	100	1	21	21	0	0	0	0	0	0		
													0	0		0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	2	2	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		1.5	30
critical point phenomena	LHe	150	28.75	0	100	0	1	1	1	0	28.75	0	0	150	0		
													0	0		28.75	150
critical point phenomena	LN2	30	24.18	0	100	0	1	1	1	0	24.18	0	0	30	0		
freezer	LN2	0	0	0	100	0	0	0	1	0	0	0	0	0	0		
gas chromatograph - mass spectrometer	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		24.18	30
high performance liquid chromatograph	methenol	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
cutting/polishing system	oil- water solu	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
water deionizer/depyrogenizer	process resin	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
solution crystal	solvents	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	2	2	0.01	0	0	0.02	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
solution crystal	test tubes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
													0	0		1.51	30.02
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	18	18	0.000073	0	0	0.000079	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	21	21	0.000085	0	0	0.000092	0	0		
autoignition furnace	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000013	0	0		

Consumables Based on Scenario SF4 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
float zone	wipes	0.000004	0.000004	100	0	0	1	6	6	0.000024	0	0	0.000024	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	70	70	0.000285	0	0	0.000308	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	37	37	0.000150	0	0	0.000162	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	5	5	0.000020	0	0	0.000022	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000697	0.00075
									Totals	3.013237	606.45	37.33320	60.02329	733.52	42670	646.7964	43463.54

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Samples Based on Scenario SF4

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
solid surface burning	fuel - solid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	burn catalytic	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel, liquid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	fuel - gaseous	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	2	2	0	10	0	0	10	0		
isoelectric focusing	raw material	0.1	0.15	0	100	0	1	4	4	0	0.6	0	0	0.4	0		
organic & polymer crystal growth	buffer solution	34.4025	34.4025	0	100	0	1	70	70	0	2408.175	0	0	2408.175	0		
bioreactor/incubator	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	staining soluti	0.01	0.01	0	100	0	1	4	4	0	0.04	0	0	0.04	0		
continuous flow electrophoresis	raw material	0.3	0.4	0	100	0	1	2	2	0	0.8	0	0	0.6	0		
contact angle measurement unit	test fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	TGS solution	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	seed crystals	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
fluid physics	TGS solution	2	3.36	0	100	0	1	2	2	0	6.72	0	0	4	0		
protein crystal growth	reservior solut	0.00675	0.0135	0	100	0	1	37	37	0	0.4995	0	0	0.24975	0		
etching equipment	etchant solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
atmospheric microphysics	acid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	monomer/polymer	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
latex reactor	AMBN process in	0.25	0.2275	0	100	0	1	4	4	0	0.91	0	0	1	0		
latex reactor	styrene	0.75	0.6825	0	100	0	1	4	4	0	2.73	0	0	3	0		
continuous flow electrophoresis	staining soluti	0.01	0.01	0	100	0	1	2	2	0	0.02	0	0	0.02	0		
continuous flow electrophoresis	buffer solution	2.7	3.5	0	100	0	1	2	2	0	7	0	0	5.4	0		
isoelectric focusing	acid	0.3	0.375	0	100	0	1	4	4	0	1.5	0	0	1.2	0		
solution crystal	crystal solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	seed crystal	0.002	0.00164	0	100	0	1	2	2	0	0.00328	0	0	0.004	0		
rotating spherical convection	dielectric stud	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	protein solutin	0.02	0.02	0	100	0	1	37	37	0	0.74	0	0	0.74	0		
bulk crystal	liquid phase en	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	100	0	1	2	2	0	0.5	0	0	0.5	0		
bioreactor/incubator	raw material	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	disinfectant /	0.25	0.25	0	100	0	1	4	4	0	1	0	0	1	0		
isoelectric focusing	calibration sol	0.3	0.3	0	100	0	1	4	4	0	1.2	0	0	1.2	0		
protein crystal growth	disinfectants	0.001	0.001	0	100	0	1	37	37	0	0.037	0	0	0.037	0		
isoelectric focusing	amphoylte conce	0.15	0.3	0	100	0	1	4	4	0	1.2	0	0	0.6	0		
latex reactor	latex solutions	1	0.91	0	100	0	1	4	4	0	3.64	0	0	4	0		
membrane production	catalyst soluti	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	basic solution	0.3	0.435	0	100	0	1	4	4	0	1.74	0	0	1.2	0		
high performance liquid chromatograph	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																2449.054	2443.365
autoignition furnace	fuel sample - s	0	0	33.3	33.3	33.3	0	0	0	0	0	0	0	0	0		
																0	0
electroepitaxy	III-V group sou	2	11	50	50	0	1	2	2	11	11	0	2	2	0		
																22	4
free float	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	microcarrier be	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
float zone	raw material	0.1288	0.966	100	0	0	1	6	6	5.796	0	0	0.7728	0	0		
organic & polymer crystal growth	acetonitrile	33.36	36.696	100	0	0	1	70	70	2568.72	0	0	2335.2	0	0		
acoustic levitator	raw material	0.1	0.6	100	0	0	1	18	18	10.8	0	0	1.8	0	0		
organic & polymer crystal growth	polydiacetylene	0.1288	0.2576	100	0	0	1	70	70	18.032	0	0	9.016	0	0		

Samples Based on Scenario SF4

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili- zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
EM levitator	raw material	0.00177	0.033	100	0	0	1	57	57	1.881	0	0	0.10089	0	0		
optical fiber pulling	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
alloy solidification	raw material	0.66	4.93284	100	0	0	1	21	21	103.5896	0	0	13.86	0	0		
latex reactor	reactors	2	3	100	0	0	1	4	4	12	0	0	8	0	0		
electrostatic levitator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	quartz tubes	0.002	0.005	100	0	0	1	37	37	0.185	0	0	0.074	0	0		
cleaning equipment	solid waste	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, large	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bulk crystal	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	semiconductor o	0.2	1.8	100	0	0	1	5	5	9	0	0	1	0	0		
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	37	37	0.00925	0	0	0.01295	0	0		
protein crystal growth	growth syringes	5	2	100	0	0	1	37	37	74	0	0	185	0	0		
water deionizer/depyrogenizer	filter cartridg	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	naphthalene	1.0425	1.0425	100	0	0	1	70	70	72.975	0	0	72.975	0	0		
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	sample material	0.315	2.523	100	0	0	1	3	3	7.569	0	0	0.945	0	0		
cutting/polishing system	encapsulant mat	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																2884.556	2628.756
								Totals		2895.556	2460.054	0	2630.756	2445.365	0	5355.611	5076.122

Waste Requirements Based on Scenario SF4

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili- zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
high performance liquid chromatograph	acetonitrile	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
atmospheric microphysics	acid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
isoelectric focusing	acid	0.3	0.375	0	99	1	1	4	4	0	1.485	0.015	0	1.188	0.012		
																1.5	1.2
acoustic levitator	air	10	0.01312	0	0	100	1	18	18	0	0	0.23616	0	0	180		
alloy solidification	air	200	0.256	0	0	100	1	21	21	0	0	5.376	0	0	4200		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	3	3	0	0	0.168	0	0	135		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	2	2	0	0	0.00512	0	0	4		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
FM levitator	air	24	0.03072	0	0	100	1	57	57	0	0	1.75104	0	0	1368		
float zone	air	5	0.005973	0	0	100	1	6	6	0	0	0.03584	0	0	30		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	5	5	0	0	0.360075	0	0	280		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																7.932235	6197
isoelectric focusing	amphoylte conce	0.15	0.3	0	99	1	1	4	4	0	1.188	0.012	0	0.594	0.006		
																1.2	0.6
bridgman, large	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	ampoule fragmen	0.001	0.0001	100	0	0	1	3	6	0.0006	0	0	0.006	0	0		
bulk crystal	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.0006	0.006
acoustic levitator	Ar	41	0.052726	0	0	100	1	18	18	0	0	0.949068	0	0	738		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	3	3	0	0	0.233625	0	0	135		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
FM levitator	Ar	24	0.04272	0	0	100	1	57	57	0	0	2.43504	0	0	1368		
float zone	Ar	14	0.02492	0	0	100	1	6	6	0	0	0.14952	0	0	84		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	37	37	0	0	2.37096	0	0	1332		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	5	5	0	0	0.178	0	0	100		
																6.316213	3757
isoelectric focusing	basic solution	0.3	0.435	0	99	1	1	4	4	0	1.7226	0.0174	0	1.188	0.012		

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Waste Requirements Based on Scenario SF4

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
																1.74	1.2
UV sterilization unit	biological wast	0	0	89.98	10	0.01	0	0	0	0	0	0	0	0	0		
																0	0
cutting/polishing system	boule fragments	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	buffer solution	2.7	3.5	2	97.9	0.1	1	2	2	0.14	6.853	0.007	0.108	5.2866	0.0054		
																7	5.4
isoelectric focusing	calibration sol	0.3	0.3	0	99.9	0.1	1	4	4	0	1.1988	0.0012	0	1.1988	0.0012		
																1.2	1.2
membrane production	catalyst soluti	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																0	0
acoustic levitator	cleaning fluid	1	1	0	99	1	1	18	18	0	17.82	0.18	0	17.82	0.18		
alloy solidification	cleaning fluid	1	1	0	99	1	1	21	21	0	20.79	0.21	0	20.79	0.21		
atmospheric microphysics	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	99	1	1	3	3	0	1.485	0.015	0	1.485	0.015		
bulk crystal	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	99	1	1	1	1	0	0.99	0.01	0	0.99	0.01		
droplet/spray burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	99	1	1	57	57	0	0.5643	0.0057	0	0.5643	0.0057		
float zone	cleaning fluid	0.1	0.1	0	99	1	1	6	6	0	0.594	0.006	0	0.594	0.006		
fluid physics	cleaning fluid	0.1	0.1	0	99	1	1	2	2	0	0.198	0.002	0	0.198	0.002		
free float	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	99	1	1	70	70	0	0.693	0.007	0	0.693	0.007		
premixed gas combustion	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	99	1	1	5	5	0	0.0495	0.0005	0	0.0495	0.0005		
variable flow shell generator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																43.62	43.62
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
autoignition furnace	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
droplet/spray burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
premixed gas combustion	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
solid surface burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
																0	0
critical point phenomena	cryogen	0	0	0	0	64560	1	1	1	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	2	2	0	10	0	0	10	0		
																10	10
atmospheric microphysics	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF4

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
autoignition furnace	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	99.9	0.1	1	6	6	0	2.997	0.003	0	2.997	0.003		
fluid physics	deionized water	1	1	0	99.9	0.1	1	2	2	0	1.998	0.002	0	1.998	0.002		
membrane production	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	99.9	0.1	1	70	70	0	69.93	0.07	0	69.93	0.07		
premixed gas combustion	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0	0	0	99.9	0.1	1	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	99.9	0.1	1	2	2	0	279.72	0.28	0	279.72	0.28		
isoelectric focusing	deion./depyro.	15	15	0	99.9	0.1	1	4	4	0	59.94	0.06	0	59.94	0.06		
protein crystal growth	deion./depyro.	0.7	0.7	0	99.9	0.1	1	37	37	0	25.8741	0.0259	0	25.8741	0.0259		
acoustic levitator	distilled water	1	1	0	99.9	0.1	1	18	18	0	17.982	0.018	0	17.982	0.018		
alloy solidification	distilled water	2	2	0	99.9	0.1	1	21	21	0	41.958	0.042	0	41.958	0.042		
autoclave	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	99.9	0.1	1	3	3	0	1.4985	0.0015	0	1.4985	0.0015		
bulk crystal	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	99.9	0.1	1	2	2	0	1.998	0.002	0	1.998	0.002		
electrostatic levitator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	99.9	0.1	1	57	57	0	5.6943	0.0057	0	5.6943	0.0057		
free float	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	99.9	0.1	1	5	5	0	2.4975	0.0025	0	2.4975	0.0025		
variable flow shell generator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																512.6	512.6
rotating spherical convection	dielectric stud	0	0	0	99.99	0.01	0	0	0	0	0	0	0	0	0		
																0	0
isoelectric focusing	disinfectant /	0.25	0.25	0	99	1	1	4	4	0	0.99	0.01	0	0.99	0.01		
bioreactor/incubator	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	99	1	1	2	2	0	0.495	0.005	0	0.495	0.005		
high performance liquid chromatograph	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
protein crystal growth	disinfectants	0.001	0.001	0	99	1	1	37	37	0	0.03663	0.00037	0	0.03663	0.00037		
																1.537	1.537
solid surface burning	fuel	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
premixed gas	fuel	0	0	0	0	10	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0		
autoignition furnace	fuel	0	0	0.333	0.333	0.333	0	0	0	0	0	0	0	0	0		
																0	0
alloy solidificaton	GHe	700	0.12495	0	0	100	1	21	21	0	0	2.62395	0	0	14700		
acoustic levitator	GHe	2	0.000355	0	0	100	1	18	18	0	0	0.00639	0	0	36		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	1	1	0	0	0.0357	0	0	200		
EM levitator	GHe	24	0.00428	0	0	100	1	57	57	0	0	0.24396	0	0	1368		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

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Waste Requirements Based on Scenario SF4

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																2.91	16304
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	18	18	0.00036	0	0	0.00036	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	21	21	0.00042	0	0	0.00042	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	3	3	0.00006	0	0	0.00006	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	70	70	0.0014	0	0	0.0014	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	5	5	0.0001	0	0	0.0001	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.00254	0.00254
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	1	1	0	0	0.25	0	0	200		
electroepitaxy	GN2	500	0.625	0	0	100	1	2	2	0	0	1.25	0	0	1000		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	2	2	0	0	0.075	0	0	60		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	37	37	0	0	16.65	0	0	13320		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																18.225	14580
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	37	37	0	0	1.90476	0	0	1332		
																1.90476	1332
protein crystal growth	growth syringes	5	2	100	0	0	1	37	37	74	0	0	185	0	0		
																74	185
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	37	37	0.00925	0	0	0.01295	0	0		
																0.00925	0.01295
alloy solidification	inert gas	0	0	0	0	100	1	21	21	0	0	0	0	0	0		
																0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	2	2	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1.5	30
critical point phenomena	LHe	150	15.489	0	0	69940	1	1	1	0	0	15.489	0	0	104910		
																15.489	104910
critical point phenomena	LN2	30	24.18	0	0	64560	1	1	1	0	0	24.18	0	0	19368		
freezer	LN2	0	0	0	0	64560	0	0	1	0	0	0	0	0	0		

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Waste Requirements Based on Scenario SF4

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
gas chromatograph - mass spectrometer	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0	24.18	19368
high performance liquid chromatograph	methonol	0	0	0	90	10	0	0	0	0	0	0	0	0	0	0	0
bioreactor/incubator	microcarrier be	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
cutting/polishing system	oil- water solu	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
water deionizer/depyrogenizer	process resin	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
protein crystal growth	protein solutio	0.02	0.02	0	99	1	1	37	37	0	0.7326	0.0074	0	0.7326	0.0074	0.74	0.74
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	37	37	0.185	0	0	0.074	0	0	0.185	0.074
cutting/polishing system	raw material	0	0	99	0	1	0	0	0	0	0	0	0	0	0	0	0
latex reactor	reactors	2	3	100	0	0	1	4	4	12	0	0	8	0	0	12	8
protein crystal growth	reservior solut	0.00675	0.0135	0	99	1	1	37	37	0	0.494505	0.004995	0	0.247252	0.002497	0.4995	0.24975
general purpose hand tools	residual gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
cleaning equipment	solid waste	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0	0	0
solution crystal	solvents	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	staining soluti	0.01	0.01	0	99	1	1	2	2	0	0.0198	0.0002	0	0.0198	0.0002		
isoelectric focusing	staining soluti	0.01	0.01	0	99	1	1	4	4	0	0.0396	0.0004	0	0.0396	0.0004	0.06	0.06
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	2	2	0.01	0	0	0.02	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
solution crystal	test tubes	0	0	100	0	0	0	0	0	0	0	0	0	0	0	1.51	30.02
solution crystal	TGS solution	0	0	0.1	49.8	0.1	1	0	0	0	0	0	0	0	0	0	0
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	18	18	0.000073	0	0	0.000079	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	21	21	0.000085	0	0	0.000092	0	0		
autoignition furnace	wipes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000013	0	0		
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		

Waste Requirements Based on Scenario SF4

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
float zone	wipes	0.000004	0.000004	100	0	0	1	6	6	0.000024	0	0	0.000026	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	70	70	0.000285	0	0	0.000308	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	37	37	0.000150	0	0	0.000162	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	5	5	0.000020	0	0	0.000022	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000697	0.000752
								Totals		89.34808	580.5267	77.98697	253.2242	577.2874	166449.0	747.8617	167279.5

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Consumables Based on Scenario SF5 Mission

Consumables Based on Scenario SF5 Mission

Facility/ Equipment | Material | Volume per run liters | mass kilogram | % solid | % liq | % gas | equip utiliz-ation | run per facility | runs per mission | solid mass kg | liquid mass kg | gas mass kg | solid volume liter | liquid volume liter | gas volume liter | total mass for material | total volume fo material

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
high performance liquid chromatograph	acetonitrile	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
										0	0	0	0	0	0	0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
acoustic levitator	air	10	0.01312	0	0	100	1	15	15	0	0	0.1968	0	0	150		
alloy solidification	air	200	0.256	0	0	100	1	12	12	0	0	3.072	0	0	2400		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	3	3	0	0	0.168	0	0	135		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	1	1	0	0	0.00256	0	0	2		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	36	36	0	0	1.10592	0	0	864		
float zone	air	5	0.005973	0	0	100	1	4	4	0	0	0.023893	0	0	20		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	3	3	0	0	0.216045	0	0	168		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		4.785218	3739
acoustic levitator	Ar	41	0.052726	0	0	100	1	15	15	0	0	0.79089	0	0	615		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	3	3	0	0	0.233625	0	0	135		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	36	36	0	0	1.53792	0	0	864		
float zone	Ar	14	0.02492	0	0	100	1	4	4	0	0	0.09968	0	0	56		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	16	16	0	0	1.02528	0	0	576		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	3	3	0	0	0.1068	0	0	60		
													0	0		3.794195	2306
acoustic levitator	cleaning fluid	1	1	0	100	0	1	15	15	0	15	0	0	15	0		

Consumables Based on Scenario SF5 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
alloy solidification	cleaning fluid	1	1	0	100	0	1	12	12	0	12	0	0	12	0		
atmospheric microphysics	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	100	0	1	3	3	0	1.5	0	0	1.5	0		
bulk crystal	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	100	0	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	100	0	1	36	36	0	0.36	0	0	0.36	0		
float zone	cleaning fluid	0.1	0.1	0	100	0	1	4	4	0	0.4	0	0	0.4	0		
fluid physics	cleaning fluid	0.1	0.1	0	100	0	1	0	0	0	0	0	0	0	0		
free float	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	100	0	1	24	24	0	0.24	0	0	0.24	0		
premixed gas combustion	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	100	0	1	3	3	0	0.03	0	0	0.03	0		
variable flow shell generator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		29.53	29.53
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
atmospheric microphysics	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	100	0	1	4	4	0	2	0	0	2	0		
fluid physics	deionized water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		
membrane production	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	100	0	1	24	24	0	24	0	0	24	0		
premixed gas combustion	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0.5	0.5	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	100	0	1	1	1	0	140	0	0	140	0		
isoelectric focusing	deion./depyro.	15	15	0	100	0	1	2	2	0	30	0	0	30	0		
protein crystal growth	deion./depyro.	0.7	0.7	0	100	0	1	16	16	0	11.2	0	0	11.2	0		
acoustic levitator	distilled water	1	1	0	100	0	1	15	15	0	15	0	0	15	0		
alloy solidification	distilled water	2	2	0	100	0	1	12	12	0	24	0	0	24	0		
autoclave	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	100	0	1	3	3	0	1.5	0	0	1.5	0		
bulk crystal	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		

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Consumables Based on Scenario SF5 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
electrostatic levitator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
FM levitator	distilled water	0.1	0.1	0	100	0	1	36	36	0	3.6	0	0	3.6	0		
free float	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	100	0	1	0	0	0	0	0	0	0	0		
variable flow shell generator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																253.3	253.3
electroepitaxy	GH2	250	0.0225	0	0	100	1	1	1	0	0	0.0225	0	0	250		
													0	0		0.0225	250
acoustic levitator	GHe	2	0.000355	0	0	100	1	15	15	0	0	0.005325	0	0	30		
alloy solidification	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
FM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.658805	9294
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	15	15	0.0003	0	0	0.0003	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	3	3	0.00006	0	0	0.00006	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	24	24	0.00048	0	0	0.00048	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	3	3	0.00006	0	0	0.00006	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.00124	0.00124
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

Consumables Based on Scenario SFS Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume for material
premixed gas combustion	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	16	16	0	0	7.2	0	0	5760		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		7.8625	6290
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	16	16	0	0	0.82368	0	0	576		
solid surface burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0.82368	576
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0		
													0	0		0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.75	15
critical point phenomena	lHe	150	28.75	0	100	0	1	0	0	0	0	0	0	0	0		
													0	0		0	0
critical point phenomena	LN2	30	24.18	0	100	0	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	100	0	0	0	1	0	0	0	0	0	0		
gas chromatograph - mass spectrometer	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
high performance liquid chromatograph	methenol	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
cutting/polishing system	oil- water solu	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
water deionizer/depyrogenizer	process resin	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
solution crystal	solvents	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
													0	0		0.755	15.01
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	15	15	0.000061	0	0	0.000066	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000049	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000013	0	0		

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Consumables Based on Scenario SES Mission

Facility/ Equipment	Material	Volume per run liter	mass kilogram	% solid	% liq	% gas	equip utilization	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
float zone	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000016	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	24	24	0.000097	0	0	0.000105	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	16	16	0.000065	0	0	0.000070	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000013	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000334	0.000359
									Totals	1.506574	282.83	18.94689	30.01159	282.83	22455	303.2834	22767.84

Samples Based on Scenario SF5

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
solid surface burning	fuel - solid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	burn catalytic	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel, liquid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	fuel - gaseous	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0		
isoelectric focusing	raw material	0.1	0.15	0	100	0	1	2	2	0	0.3	0	0	0.2	0		
organic & polymer crystal growth	buffer solution	34.4025	34.4025	0	100	0	1	24	24	0	825.66	0	0	825.66	0		
bioreactor/incubator	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	staining soluti	0.01	0.01	0	100	0	1	2	2	0	0.02	0	0	0.02	0		
continuous flow electrophoresis	raw material	0.3	0.4	0	100	0	1	1	1	0	0.4	0	0	0.3	0		
contact angle measurement unit	test fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	TGS solution	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	seed crystals	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
fluid physics	TGS solution	2	3.36	0	100	0	1	1	1	0	3.36	0	0	2	0		
protein crystal growth	reservior solut	0.00675	0.0135	0	100	0	1	16	16	0	0.216	0	0	0.108	0		
etching equipment	etchant solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
atmospheric microphysics	acid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	monomer/polymer	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
latex reactor	AMBN process in	0.25	0.2275	0	100	0	1	2	2	0	0.455	0	0	0.5	0		
latex reactor	styrene	0.75	0.6825	0	100	0	1	2	2	0	1.365	0	0	1.5	0		
continuous flow electrophoresis	staining soluti	0.01	0.01	0	100	0	1	1	1	0	0.01	0	0	0.01	0		
continuous flow electrophoresis	buffer solution	2.7	3.5	0	100	0	1	1	1	0	3.5	0	0	2.7	0		
isoelectric focusing	acid	0.3	0.375	0	100	0	1	2	2	0	0.75	0	0	0.6	0		
solution crystal	crystal solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	seed crystal	0.002	0.00164	0	100	0	1	1	1	0	0.00164	0	0	0.002	0		
rotating spherical convection	dielectric stud	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	protein solutio	0.02	0.02	0	100	0	1	16	16	0	0.32	0	0	0.32	0		
bulk crystal	liquid phase en	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	100	0	1	1	1	0	0.25	0	0	0.25	0		
bioreactor/incubator	raw material	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	disinfectant /	0.25	0.25	0	100	0	1	2	2	0	0.5	0	0	0.5	0		
isoelectric focusing	calibration sol	0.3	0.3	0	100	0	1	2	2	0	0.6	0	0	0.6	0		
protein crystal growth	disinfectants	0.001	0.001	0	100	0	1	16	16	0	0.016	0	0	0.016	0		
isoelectric focusing	amphoylte conce	0.15	0.3	0	100	0	1	2	2	0	0.6	0	0	0.3	0		
latex reactor	latex solutions	1	0.91	0	100	0	1	2	2	0	1.82	0	0	2	0		
membrane production	catalyst soluti	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	basic solution	0.3	0.435	0	100	0	1	2	2	0	0.87	0	0	0.6	0		
high performance liquid chromatograph	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																846.0136	843.186
autoignition furnace	fuel sample - s	0	0	33.3	33.3	33.3	0	0	0	0	0	0	0	0	0		
																0	0
electroepitaxy	III-V group sou	2	11	50	50	0	1	1	1	5.5	5.5	0	1	1	0		
																11	2
free float	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	microcarrier be	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
float zone	raw material	0.1288	0.966	100	0	0	1	4	4	3.864	0	0	0.5152	0	0		
organic & polymer crystal growth	acetonitrile	33.36	36.696	100	0	0	1	24	24	880.704	0	0	800.64	0	0		
acoustic levitator	raw material	0.1	0.6	100	0	0	1	15	15	9	0	0	1.5	0	0		
organic & polymer crystal growth	polydiacetylene	0.1288	0.2576	100	0	0	1	24	24	6.1824	0	0	3.0912	0	0		

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Samples Based on Scenario SF5

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
EM levitator	raw material	0.00177	0.033	100	0	0	1	36	36	1.188	0	0	0.06372	0	0		
optical fiber pulling	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
alloy solidification	raw material	0.66	4.93284	100	0	0	1	12	12	59.19408	0	0	7.92	0	0		
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0		
electrostatic levitator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	16	16	0.08	0	0	0.032	0	0		
cleaning equipment	solid waste	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, large	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bulk crystal	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	semiconductor o	0.2	1.8	100	0	0	1	3	3	5.4	0	0	0.6	0	0		
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	16	16	0.004	0	0	0.0056	0	0		
protein crystal growth	growth syringes	5	2	100	0	0	1	16	16	32	0	0	80	0	0		
water deionizer/depyrogenizer	filter cartridg	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	naphthalene	1.0425	1.0425	100	0	0	1	24	24	25.02	0	0	25.02	0	0		
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	sample material	0.315	2.523	100	0	0	1	3	3	7.569	0	0	0.945	0	0		
cutting/polishing system	encapsulant mat	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1036.205	924.3327
								Totals		1041.705	851.5136	0	925.3327	844.186	0	1893.219	1769.518

Waste Requirements Based on Scenario SF5

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
high performance liquid chromatograph	acetonitrile	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
atmospheric microphysics	acid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
isoelectric focusing	acid	0.3	0.375	0	99	1	1	2	2	0	0.7425	0.0075	0	0.594	0.006		
																0.75	0.6
acoustic levitator	air	10	0.01312	0	0	100	1	15	15	0	0	0.1968	0	0	150		
alloy solidification	air	200	0.256	0	0	100	1	12	12	0	0	3.072	0	0	2400		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	3	3	0	0	0.168	0	0	135		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	1	1	0	0	0.00256	0	0	2		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	36	36	0	0	1.10592	0	0	864		
float zone	air	5	0.005973	0	0	100	1	4	4	0	0	0.023893	0	0	20		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	3	3	0	0	0.216045	0	0	168		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																4.785218	3739
isoelectric focusing	amphoylte conce	0.15	0.3	0	99	1	1	2	2	0	0.594	0.006	0	0.297	0.003		
																0.6	0.3
bridgman, large	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	ampoule fragmen	0.001	0.0001	100	0	0	1	3	6	0.0006	0	0	0.006	0	0		
bulk crystal	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.0006	0.006
acoustic levitator	Ar	41	0.052726	0	0	100	1	15	15	0	0	0.79089	0	0	615		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	3	3	0	0	0.233625	0	0	135		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	36	36	0	0	1.53792	0	0	864		
float zone	Ar	14	0.02492	0	0	100	1	4	4	0	0	0.09968	0	0	56		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	16	16	0	0	1.02528	0	0	576		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	3	3	0	0	0.1068	0	0	60		
																3.794195	2306
isoelectric focusing	basic solution	0.3	0.435	0	99	1	1	2	2	0	0.8613	0.0087	0	0.594	0.006		

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Waste Requirement Based on Scenario SE5

Facility/ Equipment .	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
																0.87	0.6
UV sterilization unit	biological wast	0	0	89.98	10	0.01	0	0	0	0	0	0	0	0	0		
																0	0
cutting/polishing system	boule fragments	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	buffer solution	2.7	3.5	2	97.9	0.1	1	1	1	0.07	3.4265	0.0035	0.054	2.6433	0.0027		
																3.5	2.7
isoelectric focusing	calibration sol	0.3	0.3	0	99.9	0.1	1	2	2	0	0.5994	0.0006	0	0.5994	0.0006		
																0.6	0.6
membrane production	catalyst soluti	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																0	0
acoustic levitator	cleaning fluid	1	1	0	99	1	1	15	15	0	14.85	0.15	0	14.85	0.15		
alloy solidification	cleaning fluid	1	1	0	99	1	1	12	12	0	11.88	0.12	0	11.88	0.12		
atmospheric microphysics	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	99	1	1	3	3	0	1.485	0.015	0	1.485	0.015		
bulk crystal	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	99	1	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	99	1	1	36	36	0	0.3564	0.0036	0	0.3564	0.0036		
float zone	cleaning fluid	0.1	0.1	0	99	1	1	4	4	0	0.396	0.004	0	0.396	0.004		
fluid physics	cleaning fluid	0.1	0.1	0	99	1	1	1	1	0	0.099	0.001	0	0.099	0.001		
free float	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	99	1	1	24	24	0	0.2376	0.0024	0	0.2376	0.0024		
premixed gas combustion	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	99	1	1	3	3	0	0.0297	0.0003	0	0.0297	0.0003		
variable flow shell generator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																29.63	29.63
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubater	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
autoignition furnace	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
droplet/spray burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
premixed gas combustion	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
solid surface burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
																0	0
critical point phenomena	cryogen	0	0	0	0	64560	1	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0		
																5	5
atmospheric microphysics	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		

Waste Requirement: Based on Scenario SF5

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
autoignition furnace	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	99.9	0.1	1	4	4	0	1.998	0.002	0	1.998	0.002		
fluid physics	deionized water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
membrane production	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	99.9	0.1	1	24	24	0	23.976	0.024	0	23.976	0.024		
premixed gas combustion	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0	0	0	99.9	0.1	1	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	99.9	0.1	1	1	1	0	139.86	0.14	0	139.86	0.14		
isoelectric focusing	deion./depyro.	15	15	0	99.9	0.1	1	2	2	0	29.97	0.03	0	29.97	0.03		
protein crystal growth	deion./depyro.	0.7	0.7	0	99.9	0.1	1	16	16	0	11.1888	0.0112	0	11.1888	0.0112		
acoustic levitator	distilled water	1	1	0	99.9	0.1	1	15	15	0	14.985	0.015	0	14.985	0.015		
alloy solidification	distilled water	2	2	0	99.9	0.1	1	12	12	0	23.976	0.024	0	23.976	0.024		
autoclave	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	99.9	0.1	1	3	3	0	1.4985	0.0015	0	1.4985	0.0015		
bulk crystal	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
electrostatic levitator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
FM levitator	distilled water	0.1	0.1	0	99.9	0.1	1	36	36	0	3.5964	0.0036	0	3.5964	0.0036		
free float	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	99.9	0.1	1	3	3	0	1.4985	0.0015	0	1.4985	0.0015		
variable flow shell generator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																254.8	254.8
rotating spherical convection	dielectric stud	0	0	0	99.99	0.01	0	0	0	0	0	0	0	0	0		
																0	0
isoelectric focusing	disinfectant /	0.25	0.25	0	99	1	1	2	2	0	0.495	0.005	0	0.495	0.005		
bioreactor/incubator	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	99	1	1	1	1	0	0.2475	0.0025	0	0.2475	0.0025		
high performance liquid chromatograph	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
protein crystal growth	disinfectants	0.001	0.001	0	99	1	1	16	16	0	0.01584	0.00016	0	0.01584	0.00016		
																0.766	0.766
solid surface burning	fuel	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
premixed gas	fuel	0	0	0	0	10	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0		
autoignition furnace	fuel	0	0	0.333	0.333	0.333	0	0	0	0	0	0	0	0	0		
																0	0
alloy solidificaton	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
acoustic levitator	GHe	2	0.000355	0	0	100	1	15	15	0	0	0.005325	0	0	30		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
FM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

Waste Requirements Based on Scenario SL5

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utilization	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0	1.658805	9294
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	15	15	0.0003	0	0	0.0003	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	3	3	0.00006	0	0	0.00006	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	24	24	0.00048	0	0	0.00048	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	3	3	0.00006	0	0	0.00006	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.00124	0.00124
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	16	16	0	0	7.2	0	0	5760		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0	7.8625	6290
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	16	16	0	0	0.82368	0	0	576	0.82368	576
protein crystal growth	growth syringes	5	2	100	0	0	1	16	16	32	0	0	80	0	0	32	80
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	16	16	0.004	0	0	0.0056	0	0	0.004	0.0056
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0	0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.75	15
critical point phenomena	LHe	150	15.489	0	0	69940	1	0	0	0	0	0	0	0	0	0	0
critical point phenomena	LN2	30	24.18	0	0	64560	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	0	64560	0	0	1	0	0	0	0	0	0		

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Waste Requirement Based on Scenario SFS

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
gas chromatograph - mass spectrometer	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0	0	0
scanning electron microscope	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	methonol	0	0	0	90	10	0	0	0	0	0	0	0	0	0	0	0
bioreactor/incubator	microcarrier be	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
cutting/polishing system	oil- water solu	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
water deionizer/depyrogenizer	process resin	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
protein crystal growth	protein solutio	0.02	0.02	0	99	1	1	16	16	0	0.3168	0.0032	0	0.3168	0.0032	0.32	0.32
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	16	16	0.08	0	0	0.032	0	0	0.08	0.032
cutting/polishing system	raw material	0	0	99	0	1	0	0	0	0	0	0	0	0	0	0	0
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0	6	4
protein crystal growth	reservior solut	0.00675	0.0135	0	99	1	1	16	16	0	0.21384	0.00216	0	0.10692	0.00108	0.216	0.108
general purpose hand tools	residual gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
cleaning equipment	solid waste	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0	0	0
solution crystal	solvents	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	staining soluti	0.01	0.01	0	99	1	1	1	1	0	0.0099	0.0001	0	0.0099	0.0001	0.03	0.03
isoelectric focusing	staining soluti	0.01	0.01	0	99	1	1	2	2	0	0.0198	0.0002	0	0.0198	0.0002		
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0	0.755	15.01
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	TGS solution	0	0	0.1	49.8	0.1	1	0	0	0	0	0	0	0	0	0	0
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	15	15	0.000061	0	0	0.000066	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000048	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000013	0	0		
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
alloy solidification	cleaning fluid	1	1	0	100	0	1	12	12	0	12	0	0	12	0		
atmospheric microphysics	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	100	0	1	5	5	0	2.5	0	0	2.5	0		
bulk crystal	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	100	0	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	100	0	1	36	36	0	0.36	0	0	0.36	0		
float zone	cleaning fluid	0.1	0.1	0	100	0	1	9	9	0	0.9	0	0	0.9	0		
fluid physics	cleaning fluid	0.1	0.1	0	100	0	1	0	0	0	0	0	0	0	0		
free float	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	100	0	1	27	27	0	0.27	0	0	0.27	0		
premixed gas combustion	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	100	0	1	4	4	0	0.04	0	0	0.04	0		
variable flow shell generator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		39.07	39.07
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
atmospheric microphysics	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	100	0	1	9	9	0	4.5	0	0	4.5	0		
fluid physics	deionized water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		
membrane production	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	100	0	1	27	27	0	27	0	0	27	0		
premixed gas combustion	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0.5	0.5	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	100	0	1	1	1	0	140	0	0	140	0		
isoelectric focusing	deion./depyro.	15	15	0	100	0	1	2	2	0	30	0	0	30	0		
protein crystal growth	deion./depyro.	0.7	0.7	0	100	0	1	20	20	0	14	0	0	14	0		
acoustic levitator	distilled water	1	1	0	100	0	1	23	23	0	23	0	0	23	0		
alloy solidification	distilled water	2	2	0	100	0	1	12	12	0	24	0	0	24	0		
autoclave	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	100	0	1	5	5	0	2.5	0	0	2.5	0		
bulk crystal	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		

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Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
electrostatic levitator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	100	0	1	36	36	0	3.6	0	0	3.6	0		
free float	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	100	0	1	0	0	0	0	0	0	0	0		
variable flow shell generator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																270.6	270.6
electroepitaxy	GH2	250	0.0225	0	0	100	1	1	1	0	0	0.0225	0	0	250		
													0	0		0.0225	250
acoustic levitator	GHe	2	0.000355	0	0	100	1	23	23	0	0	0.008165	0	0	46		
alloy solidification	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.661645	9310
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	23	23	0.00046	0	0	0.00046	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	5	5	0.0001	0	0	0.0001	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	27	27	0.00054	0	0	0.00054	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.00152	0.00152
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
premixed gas combustion	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	20	20	0	0	9	0	0	7200		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		9.6625	7730
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	20	20	0	0	1.0296	0	0	720		
solid surface burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.0296	720
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0		
													0	0		0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.75	15
critical point phenomena	LHe	150	28.75	0	100	0	1	0	0	0	0	0	0	0	0		
													0	0		0	0
critical point phenomena	LN2	30	24.18	0	100	0	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	100	0	0	0	1	0	0	0	0	0	0		
gas chromatograph - mass spectrometer	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
high performance liquid chromatograph	methenol	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
cutting/polishing system	oil- water solu	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
water deionizer/depyrogenizer	process resin	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
solution crystal	solvents	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
													0	0		0.755	15.01
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	23	23	0.000093	0	0	0.000101	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000048	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small.	wipes	0.000004	0.000004	100	0	0	1	5	5	0.000020	0	0	0.000022	0	0		

Consumables Based on Scenario SF6 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
float zone	wipes	0.000004	0.000004	100	0	0	1	9	9	0.000036	0	0	0.000036	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	27	27	0.000110	0	0	0.000118	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000428	0.000458
									Totals	1.506948	309.67	22.26857	30.01197	309.67	24958	333.4455	25297.68

Samples Based on Scenario SF6

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili- zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
solid surface burning	fuel - solid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	burn catalytic	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel, liquid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	fuel - gaseous	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0		
isoelectric focusing	raw material	0.1	0.15	0	100	0	1	2	2	0	0.3	0	0	0.2	0		
organic & polymer crystal growth	buffer solution	34.4025	34.4025	0	100	0	1	27	27	0	928.8675	0	0	928.8675	0		
bioreactor/incubator	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	staining soluti	0.01	0.01	0	100	0	1	2	2	0	0.02	0	0	0.02	0		
continuous flow electrophoresis	raw material	0.3	0.4	0	100	0	1	1	1	0	0.4	0	0	0.3	0		
contact angle measurement unit	test fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	TGS solution	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	seed crystals	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
fluid physics	TGS solution	2	3.36	0	100	0	1	1	1	0	3.36	0	0	2	0		
protein crystal growth	reservior solut	0.00675	0.0135	0	100	0	1	20	20	0	0.27	0	0	0.135	0		
etching equipment	etchant solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
atmospheric microphysics	acid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	monomer/polymer	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
latex reactor	AMBN process in	0.25	0.2275	0	100	0	1	2	2	0	0.455	0	0	0.5	0		
latex reactor	styrene	0.75	0.6825	0	100	0	1	2	2	0	1.365	0	0	1.5	0		
continuous flow electrophoresis	staining soluti	0.01	0.01	0	100	0	1	1	1	0	0.01	0	0	0.01	0		
continuous flow electrophoresis	buffer solution	2.7	3.5	0	100	0	1	1	1	0	3.5	0	0	2.7	0		
isoelectric focusing	acid	0.3	0.375	0	100	0	1	2	2	0	0.75	0	0	0.6	0		
solution crystal	crystal solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	seed crystal	0.002	0.00164	0	100	0	1	1	1	0	0.00164	0	0	0.002	0		
rotating spherical convection	dielectric stud	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	protein solutio	0.02	0.02	0	100	0	1	20	20	0	0.4	0	0	0.4	0		
bulk crystal	liquid phase en	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	100	0	1	1	1	0	0.25	0	0	0.25	0		
bioreactor/incubator	raw material	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	disinfectant /	0.25	0.25	0	100	0	1	2	2	0	0.5	0	0	0.5	0		
isoelectric focusing	calibration sol	0.3	0.3	0	100	0	1	2	2	0	0.6	0	0	0.6	0		
protein crystal growth	disinfectants	0.001	0.001	0	100	0	1	20	20	0	0.02	0	0	0.02	0		
isoelectric focusing	amphoylte conce	0.15	0.3	0	100	0	1	2	2	0	0.6	0	0	0.3	0		
latex reactor	latex solutions	1	0.91	0	100	0	1	2	2	0	1.82	0	0	2	0		
membrane production	catalyst soluti	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	basic solution	0.3	0.435	0	100	0	1	2	2	0	0.87	0	0	0.6	0		
high performance liquid chromatograph	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																949.3591	946.5045
autoignition furnace	fuel sample - s	0	0	33.3	33.3	33.3	0	0	0	0	0	0	0	0	0		
																0	0
electroepitaxy	III-V group sou	2	11	50	50	0	1	1	1	5.5	5.5	0	1	1	0		
																11	2
free float	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	microcarrier be	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
float zone	raw material	0.1288	0.966	100	0	0	1	9	9	8.694	0	0	1.1592	0	0		
organic & polymer crystal growth	acetonitrile	33.36	36.696	100	0	0	1	27	27	990.792	0	0	900.72	0	0		
acoustic levitator	raw material	0.1	0.6	100	0	0	1	23	23	13.8	0	0	2.3	0	0		
organic & polymer crystal growth	polydiacetylene	0.1288	0.2576	100	0	0	1	27	27	6.9552	0	0	3.4776	0	0		

Samples Based on Scenario SF6

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili- zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
EM levitator	raw material	0.00177	0.033	100	0	0	1	36	36	1.188	0	0	0.06372	0	0		
optical fiber pulling	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
alloy solidification	raw material	0.66	4.93284	100	0	0	1	12	12	59.19408	0	0	7.92	0	0		
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0		
electrostatic levitator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	20	20	0.1	0	0	0.04	0	0		
cleaning equipment	solid waste	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, large	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bulk crystal	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	semiconductor o	0.2	1.8	100	0	0	1	4	4	7.2	0	0	0.8	0	0		
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	20	20	0.005	0	0	0.007	0	0		
protein crystal growth	growth syringes	5	2	100	0	0	1	20	20	40	0	0	100	0	0		
water deionizer/depyrogenizer	filter cartridg	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	naphthalene	1.0425	1.0425	100	0	0	1	27	27	28.1475	0	0	28.1475	0	0		
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	sample material	0.315	2.523	100	0	0	1	5	5	12.615	0	0	1.575	0	0		
cutting/polishing system	encapsulant mat	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1174.690	1050.210
								Totals		1180.190	954.8591	0	1051.210	947.5045	0	2135.049	1998.714

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Waste Requirements Based on Scenario SF6

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili- zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
high performance liquid chromatograph	acetonitrile	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
atmospheric microphysics	acid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
isoelectric focusing	acid	0.3	0.375	0	99	1	1	2	2	0	0.7425	0.0075	0	0.594	0.006		
																0.75	0.6
acoustic levitator	air	10	0.01312	0	0	100	1	23	23	0	0	0.30176	0	0	230		
alloy solidification	air	200	0.256	0	0	100	1	12	12	0	0	3.072	0	0	2400		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	5	5	0	0	0.28	0	0	225		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	1	1	0	0	0.00256	0	0	2		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	36	36	0	0	1.10592	0	0	864		
float zone	air	5	0.005973	0	0	100	1	9	9	0	0	0.05376	0	0	45		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	4	4	0	0	0.28806	0	0	224		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																5.10406	3990
isoelectric focusing	amphoylte conce	0.15	0.3	0	99	1	1	2	2	0	0.594	0.006	0	0.297	0.003		
																0.6	0.3
bridgman, large	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	ampoule fragmen	0.001	0.0001	100	0	0	1	5	6	0.0006	0	0	0.006	0	0		
bulk crystal	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.0006	0.006
acoustic levitator	Ar	41	0.052726	0	0	100	1	23	23	0	0	1.212698	0	0	943		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	5	5	0	0	0.389375	0	0	225		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	36	36	0	0	1.53792	0	0	864		
float zone	Ar	14	0.02492	0	0	100	1	9	9	0	0	0.22428	0	0	126		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	20	20	0	0	1.2816	0	0	720		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	4	4	0	0	0.1424	0	0	80		
																4.788273	2958
isoelectric focusing	basic solution	0.3	0.435	0	99	1	1	2	2	0	0.8613	0.0087	0	0.594	0.006		

Waste Requirements Based on Scenario SF6

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
																0.87	0.6
UV sterilization unit	biological wast	0	0	89.98	10	0.01	0	0	0	0	0	0	0	0	0	0	0
cutting/polishing system	boule fragments	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	buffer solution	2.7	3.5	2	97.9	0.1	1	1	1	0.07	3.4265	0.0035	0.054	2.6433	0.0027	3.5	2.7
isoelectric focusing	calibration sol	0.3	0.3	0	99.9	0.1	1	2	2	0	0.5994	0.0006	0	0.5994	0.0006	0.6	0.6
membrane production	catalyst soluti	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
acoustic levitator	cleaning fluid	1	1	0	99	1	1	23	23	0	22.77	0.23	0	22.77	0.23		
alloy solidification	cleaning fluid	1	1	0	99	1	1	12	12	0	11.88	0.12	0	11.88	0.12		
atmospheric microphysics	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	99	1	1	5	5	0	2.475	0.025	0	2.475	0.025		
bulk crystal	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	99	1	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	99	1	1	36	36	0	0.3564	0.0036	0	0.3564	0.0036		
float zone	cleaning fluid	0.1	0.1	0	99	1	1	9	9	0	0.891	0.009	0	0.891	0.009		
fluid physics	cleaning fluid	0.1	0.1	0	99	1	1	1	1	0	0.099	0.001	0	0.099	0.001		
free float	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	99	1	1	27	27	0	0.2673	0.0027	0	0.2673	0.0027		
premixed gas combustion	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	99	1	1	4	4	0	0.0396	0.0004	0	0.0396	0.0004		
variable flow shell generator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0	39.17	39.17
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
autoignition furnace	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
droplet/spray burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
premixed gas combustion	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
solid surface burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0	0	0
critical point phenomena	cryogen	0	0	0	0	64560	1	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0	5	5
atmospheric microphysics	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		

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Waste Requirements Based on Scenario SF6

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
autoignition furnace	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	99.9	0.1	1	9	9	0	4.4955	0.0045	0	4.4955	0.0045		
fluid physics	deionized water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
membrane production	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	99.9	0.1	1	27	27	0	26.973	0.027	0	26.973	0.027		
premixed gas combustion	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0	0	0	99.9	0.1	1	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	99.9	0.1	1	1	1	0	139.86	0.14	0	139.86	0.14		
isoelectric focusing	deion./depyro.	15	15	0	99.9	0.1	1	2	2	0	29.97	0.03	0	29.97	0.03		
protein crystal growth	deion./depyro.	0.7	0.7	0	99.9	0.1	1	20	20	0	13.986	0.014	0	13.986	0.014		
acoustic levitator	distilled water	1	1	0	99.9	0.1	1	23	23	0	22.977	0.023	0	22.977	0.023		
alloy solidification	distilled water	2	2	0	99.9	0.1	1	12	12	0	23.976	0.024	0	23.976	0.024		
autoclave	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	99.9	0.1	1	5	5	0	2.4975	0.0025	0	2.4975	0.0025		
bulk crystal	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
electrostatic levitator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	99.9	0.1	1	36	36	0	3.5964	0.0036	0	3.5964	0.0036		
free float	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	99.9	0.1	1	4	4	0	1.998	0.002	0	1.998	0.002		
variable flow shell generator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																272.6	272.6
rotating spherical convection	dielectric stud	0	0	0	99.99	0.01	0	0	0	0	0	0	0	0	0		
																0	0
isoelectric focusing	disinfectant /	0.25	0.25	0	99	1	1	2	2	0	0.495	0.005	0	0.495	0.005		
bioreactor/incubator	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	99	1	1	1	1	0	0.2475	0.0025	0	0.2475	0.0025		
high performance liquid chromatograph	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
protein crystal growth	disinfectants	0.001	0.001	0	99	1	1	20	20	0	0.0198	0.0002	0	0.0198	0.0002		
																0.77	0.77
solid surface burning	fuel	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
premixed gas	fuel	0	0	0	0	10	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0		
autoignition furnace	fuel	0	0	0.333	0.333	0.333	0	0	0	0	0	0	0	0	0		
																0	0
alloy solidificaton	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
acoustic levitator	GHe	2	0.000355	0	0	100	1	23	23	0	0	0.008165	0	0	46		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF6

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																1.661645	9310
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	23	23	0.00046	0	0	0.00046	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	5	5	0.0001	0	0	0.0001	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	27	27	0.00054	0	0	0.00054	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.00152	0.00152
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	20	20	0	0	9	0	0	7200		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																9.6625	7730
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	20	20	0	0	1.0296	0	0	720		
																1.0296	720
protein crystal growth	growth syringes	5	2	100	0	0	1	20	20	40	0	0	100	0	0		
																40	100
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	20	20	0.005	0	0	0.007	0	0		
																0.005	0.007
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0		
																0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.75	15
critical point phenomena	LHe	150	15.489	0	0	69940	1	0	0	0	0	0	0	0	0		
																0	0
critical point phenomena	LN2	30	24.18	0	0	64560	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	0	64560	0	0	1	0	0	0	0	0	0		

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Waste Requirements Based on Scenario SF6

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
gas chromatograph - mass spectrometer	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0	0	0
high performance liquid chromatograph	methonol	0	0	0	90	10	0	0	0	0	0	0	0	0	0	0	0
bioreactor/incubator	microcarrier be	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
cutting/polishing system	oil- water solu	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
water deionizer/depyrogenizer	process resin	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
protein crystal growth	protein solutio	0.02	0.02	0	99	1	1	20	20	0	0.396	0.004	0	0.396	0.004	0.4	0.4
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	20	20	0.1	0	0	0.04	0	0	0.1	0.04
cutting/polishing system	raw material	0	0	99	0	1	0	0	0	0	0	0	0	0	0	0	0
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0	6	4
protein crystal growth	reservior solut	0.00675	0.0135	0	99	1	1	20	20	0	0.2673	0.0027	0	0.13365	0.00135	0.27	- 0.135
general purpose hand tools	residual gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
cleaning equipment	solid waste	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0	0	0
solution crystal	solvents	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	staining soluti	0.01	0.01	0	99	1	1	1	1	0	0.0099	0.0001	0	0.0099	0.0001		
isoelectric focusing	staining soluti	0.01	0.01	0	99	1	1	2	2	0	0.0198	0.0002	0	0.0198	0.0002	0.03	0.03
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.755	15.01
solution crystal	TGS solution	0	0	0.1	49.8	0.1	1	0	0	0	0	0	0	0	0	0	0
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	23	23	0.000093	0	0	0.000101	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000048	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	5	5	0.000020	0	0	0.000022	0	0		
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		

Waste Requirements Based on Scenario SF6

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
float zone	wipes	0.000004	0.000004	100	0	0	1	9	9	0.000036	0	0	0.000039	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	27	27	0.000110	0	0	0.000118	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000428	0.000462
								Totals		47.68254	323.7847	22.95137	134.1189	322.1550	24708.69	394.4186	25164.96

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Consumables Based on Scenario SF7 Mission

Consumables Based on Scenario SF7 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utilization	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
										0	0	0	0	0	0		
high performance liquid chromatograph	acetonitrile	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
acoustic levitator	air	10	0.01312	0	0	100	1	17	17	0	0	0.22304	0	0	170		
alloy solidification	air	200	0.256	0	0	100	1	15	15	0	0	3.84	0	0	3000		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	3	3	0	0	0.168	0	0	135		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	2	2	0	0	0.00512	0	0	4		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	37	37	0	0	1.13664	0	0	888		
float zone	air	5	0.005973	0	0	100	1	3	3	0	0	0.01792	0	0	15		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	2	2	0	0	0.14403	0	0	112		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		5.53475	4324
acoustic levitator	Ar	41	0.052726	0	0	100	1	17	17	0	0	0.896342	0	0	697		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	3	3	0	0	0.233625	0	0	135		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	37	37	0	0	1.58064	0	0	888		
float zone	Ar	14	0.02492	0	0	100	1	3	3	0	0	0.07476	0	0	42		
gas chromatograph mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	20	20	0	0	1.2816	0	0	720		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	2	2	0	0	0.0712	0	0	40		
													0	0		4.138167	2522
acoustic levitator	cleaning fluid	1	1	0	100	0	1	17	17	0	17	0	0	17	0		

Consumables Based on Scenario SF7 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
alloy solidification	cleaning fluid	1	1	0	100	0	1	15	15	0	15	0	0	15	0		
atmospheric microphysics	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	100	0	1	3	3	0	1.5	0	0	1.5	0		
bulk crystal	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	100	0	1	1	1	0	1	0	0	1	0		
droplet/spray burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	100	0	1	37	37	0	0.37	0	0	0.37	0		
float zone	cleaning fluid	0.1	0.1	0	100	0	1	3	3	0	0.3	0	0	0.3	0		
fluid physics	cleaning fluid	0.1	0.1	0	100	0	1	0	0	0	0	0	0	0	0		
free float	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	100	0	1	41	41	0	0.41	0	0	0.41	0		
premixed gas combustion	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	100	0	1	2	2	0	0.02	0	0	0.02	0		
variable flow shell generator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		35.6	35.6
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
atmospheric microphysics	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	100	0	1	3	3	0	1.5	0	0	1.5	0		
fluid physics	deionized water	1	1	0	100	0	1	2	2	0	2	0	0	2	0		
membrane production	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	100	0	1	41	41	0	41	0	0	41	0		
premixed gas combustion	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0.5	0.5	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	100	0	1	2	2	0	280	0	0	280	0		
isoelectric focusing	deion./depyro.	15	15	0	100	0	1	4	4	0	60	0	0	60	0		
protein crystal growth	deion./depyro.	0.7	0.7	0	100	0	1	20	20	0	14	0	0	14	0		
acoustic levitator	distilled water	1	1	0	100	0	1	17	17	0	17	0	0	17	0		
alloy solidification	distilled water	2	2	0	100	0	1	15	15	0	30	0	0	30	0		
autoclave	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	100	0	1	3	3	0	1.5	0	0	1.5	0		
bulk crystal	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	100	0	1	2	2	0	2	0	0	2	0		

Consumables Based on Scenario SF7 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utilization	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
electrostatic levitator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	100	0	1	37	37	0	3.7	0	0	3.7	0		
free float	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	100	0	1	0	0	0	0	0	0	0	0		
variable flow shell generator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																452.7	452.7
electroepitaxy	GH2	250	0.0225	0	0	100	1	2	2	0	0	0.045	0	0	500		
													0	0		0.045	500
acoustic levitator	GHe	2	0.000355	0	0	100	1	17	17	0	0	0.006035	0	0	34		
alloy solidification	GHe	700	0.12495	0	0	100	1	15	15	0	0	1.87425	0	0	10500		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	1	1	0	0	0.0357	0	0	200		
droplet/spray burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	37	37	0	0	0.15836	0	0	888		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		2.074345	11622
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	17	17	0.00034	0	0	0.00034	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	15	15	0.0003	0	0	0.0003	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	3	3	0.00006	0	0	0.00006	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	41	41	0.00082	0	0	0.00082	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.00176	0.00176
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	1	1	0	0	0.25	0	0	200		
droplet/spray burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	2	2	0	0	1.25	0	0	1000		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	2	2	0	0	0.075	0	0	60		
gas chromatograph mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

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Consumables Based on Scenario SF7 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utilization	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
premixed gas combustion	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	20	20	0	0	9	0	0	7200		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		10.575	8460
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	20	20	0	0	1.0296	0	0	720		
solid surface burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.0296	720
alloy solidification	inert gas	0	0	0	0	100	1	15	15	0	0	0	0	0	0		
													0	0		0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	2	2	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		1.5	30
critical point phenomena	LHe	150	28.75	0	100	0	1	1	1	0	28.75	0	0	150	0		
													0	0		28.75	150
critical point phenomena	LN2	30	24.18	0	100	0	1	1	1	0	24.18	0	0	30	0		
freezer	LN2	0	0	0	100	0	0	0	1	0	0	0	0	0	0		
gas chromatograph - mass spectrometer	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		24.18	30
high performance liquid chromatograph	methenol	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
cutting/polishing system	oil- water solu	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
water deionizer/depyrogenizer	process resin	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
solution crystal	solvents	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	2	2	0.01	0	0	0.02	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
solution crystal	test tubes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
													0	0		1.51	30.02
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	17	17	0.000069	0	0	0.000074	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	15	15	0.000061	0	0	0.000066	0	0		
autoignition furnace	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000013	0	0		

Consumables Based on Scenario SF7 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utilization	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
float zone	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000012	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	41	41	0.000167	0	0	0.000180	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000456	0.000491
									Totals	3.012216	541.23	23.39686	60.02225	668.3	28148	567.6390	28876.32

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Samples Based on Scenario SF7

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utilization	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
solid surface burning	fuel - solid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	burn catalytic	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel, liquid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	fuel gaseous	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	2	2	0	10	0	0	10	0		
isoelectric focusing	raw material	0.1	0.15	0	100	0	1	4	4	0	0.6	0	0	0.4	0		
organic & polymer crystal growth	buffer solution	34.4025	34.4025	0	100	0	1	41	41	0	1410.502	0	0	1410.502	0		
bioreactor/incubator	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	staining soluti	0.01	0.01	0	100	0	1	4	4	0	0.04	0	0	0.04	0		
continuous flow electrophoresis	raw material	0.3	0.4	0	100	0	1	2	2	0	0.8	0	0	0.6	0		
contact angle measurement unit	test fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	TGS solution	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	seed crystals	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
fluid physics	TGS solution	2	3.36	0	100	0	1	2	2	0	6.72	0	0	4	0		
protein crystal growth	reservior solut	0.00675	0.0135	0	100	0	1	20	20	0	0.27	0	0	0.135	0		
etching equipment	etchant solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
atmospheric microphysics	acid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	monomer/polymer	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
latex reactor	AMBN process in	0.25	0.2275	0	100	0	1	4	4	0	0.91	0	0	1	0		
latex reactor	styrene	0.75	0.6825	0	100	0	1	4	4	0	2.73	0	0	3	0		
continuous flow electrophoresis	staining soluti	0.01	0.01	0	100	0	1	2	2	0	0.02	0	0	0.02	0		
continuous flow electrophoresis	buffer solution	2.7	3.5	0	100	0	1	2	2	0	7	0	0	5.4	0		
isoelectric focusing	acid	0.3	0.375	0	100	0	1	4	4	0	1.5	0	0	1.2	0		
solution crystal	crystal solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	seed crystal	0.002	0.00164	0	100	0	1	2	2	0	0.00328	0	0	0.004	0		
rotating spherical convection	dielectric stud	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	protein solutio	0.02	0.02	0	100	0	1	20	20	0	0.4	0	0	0.4	0		
bulk crystal	liquid phase en	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	100	0	1	2	2	0	0.5	0	0	0.5	0		
bioreactor/incubator	raw material	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	disinfectant /	0.25	0.25	0	100	0	1	4	4	0	1	0	0	1	0		
isoelectric focusing	calibration sol	0.3	0.3	0	100	0	1	4	4	0	1.2	0	0	1.2	0		
protein crystal growth	disinfectants	0.001	0.001	0	100	0	1	20	20	0	0.02	0	0	0.02	0		
isoelectric focusing	amphoylte conce	0.15	0.3	0	100	0	1	4	4	0	1.2	0	0	0.6	0		
latex reactor	latex solutions	1	0.91	0	100	0	1	4	4	0	3.64	0	0	4	0		
membrane production	catalyst soluti	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	basic solution	0.3	0.435	0	100	0	1	4	4	0	1.74	0	0	1.2	0		
high performance liquid chromatograph	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																1450.795	1445.221
autoignition furnace	fuel sample - s	0	0	33.3	33.3	33.3	0	0	0	0	0	0	0	0	0		
																0	0
electroepitaxy	III-V group sou	2	11	50	50	0	1	2	2	11	11	0	2	2	0		
																22	4
free float	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	microcarrier be	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
float zone	raw material	0.1288	0.966	100	0	0	1	3	3	2.898	0	0	0.3864	0	0		
organic & polymer crystal growth	acetonitrile	33.36	36.696	100	0	0	1	41	41	1504.536	0	0	1367.76	0	0		
acoustic levitator	raw material	0.1	0.6	100	0	0	1	17	17	10.2	0	0	1.7	0	0		
organic & polymer crystal growth	polydiacetylene	0.1288	0.2576	100	0	0	1	41	41	10.5616	0	0	5.2808	0	0		

Samples Based on Scenario SF7

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
EM levitator	raw material	0.00177	0.033	100	0	0	1	37	37	1.221	0	0	0.06549	0	0		
optical fiber pulling	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
alloy solidification	raw material	0.66	4.93284	100	0	0	1	15	15	73.9926	0	0	9.9	0	0		
latex reactor	reactors	2	3	100	0	0	1	4	4	12	0	0	8	0	0		
electrostatic levitator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	20	20	0.1	0	0	0.04	0	0		
cleaning equipment	solid waste	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, large	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bulk crystal	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	semiconductor o	0.2	1.8	100	0	0	1	2	2	3.6	0	0	0.4	0	0		
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	20	20	0.005	0	0	0.007	0	0		
protein crystal growth	growth syringes	5	2	100	0	0	1	20	20	40	0	0	100	0	0		
water deionizer/depyrogenizer	filter cartridg	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	naphthalene	1.0425	1.0425	100	0	0	1	41	41	42.7425	0	0	42.7425	0	0		
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	sample material	0.315	2.523	100	0	0	1	3	3	7.569	0	0	0.945	0	0		
cutting/polishing system	encapsulant mat	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1709.425	1537.227
								Totals		1720.425	1461.795	0	1539.227	1447.221	0	3182.221	2986.448

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Waste Requirements Based on Scenario SF7

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
high performance liquid chromatograph	acetonitrile	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
atmospheric microphysics	acid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
isoelectric focusing	acid	0.3	0.375	0	99	1	1	4	4	0	1.485	0.015	0	1.188	0.012		
																1.5	1.2
acoustic levitator	air	10	0.01312	0	0	100	1	17	17	0	0	0.22304	0	0	170		
alloy solidification	air	200	0.256	0	0	100	1	15	15	0	0	3.84	0	0	3000		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	3	3	0	0	0.168	0	0	135		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	2	2	0	0	0.00512	0	0	4		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	37	37	0	0	1.13664	0	0	888		
float zone	air	5	0.005973	0	0	100	1	3	3	0	0	0.01792	0	0	15		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	2	2	0	0	0.14403	0	0	112		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																5.53475	4324
isoelectric focusing	ampholyte conce	0.15	0.3	0	99	1	1	4	4	0	1.188	0.012	0	0.594	0.006		
																1.2	0.6
bridgman, large	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	ampoule fragmen	0.001	0.0001	100	0	0	1	3	6	0.0006	0	0	0.006	0	0		
bulk crystal	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.0006	0.006
acoustic levitator	Ar	41	0.052726	0	0	100	1	17	17	0	0	0.896342	0	0	697		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	3	3	0	0	0.233625	0	0	135		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	37	37	0	0	1.58064	0	0	888		
float zone	Ar	14	0.02492	0	0	100	1	3	3	0	0	0.07476	0	0	42		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	20	20	0	0	1.2816	0	0	720		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	2	2	0	0	0.0712	0	0	40		
																4.138167	2522
isoelectric focusing	basic solution	0.3	0.435	0	99	1	1	4	4	0	1.7226	0.0174	0	1.188	0.012		

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Waste Requirements Based on Scenario SF7

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
																1.74	1.2
UV sterilization unit	biological wast	0	0	89.98	10	0.01	0	0	0	0	0	0	0	0	0		
																0	0
cutting/polishing system	boule fragments	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	buffer solution	2.7	3.5	2	97.9	0.1	1	2	2	0.14	6.853	0.007	0.108	5.2866	0.0054		
																7	5.4
isoelectric focusing	calibration sol	0.3	0.3	0	99.9	0.1	1	4	4	0	1.1988	0.0012	0	1.1988	0.0012		
																1.2	1.2
membrane production	catalyst soluti	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																0	0
acoustic levitator	cleaning fluid	1	1	0	99	1	1	17	17	0	16.83	0.17	0	16.83	0.17		
alloy solidification	cleaning fluid	1	1	0	99	1	1	15	15	0	14.85	0.15	0	14.85	0.15		
atmospheric microphysics	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	99	1	1	3	3	0	1.485	0.015	0	1.485	0.015		
bulk crystal	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	99	1	1	1	1	0	0.99	0.01	0	0.99	0.01		
droplet/spray burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	99	1	1	37	37	0	0.3663	0.0037	0	0.3663	0.0037		
float zone	cleaning fluid	0.1	0.1	0	99	1	1	3	3	0	0.297	0.003	0	0.297	0.003		
fluid physics	cleaning fluid	0.1	0.1	0	99	1	1	2	2	0	0.198	0.002	0	0.198	0.002		
free float	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	99	1	1	41	41	0	0.4059	0.0041	0	0.4059	0.0041		
premixed gas combustion	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	99	1	1	2	2	0	0.0198	0.0002	0	0.0198	0.0002		
variable flow shell generator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																35.8	35.8
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
autoignition furnace	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
droplet/spray burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
premixed gas combustion	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
solid surface burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
																0	0
critical point phenomena	cryogen	0	0	0	0	64560	1	1	1	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	2	2	0	10	0	0	10	0		
																10	10
atmospheric microphysics	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF7

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
autoignition furnace	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	99.9	0.1	1	3	3	0	1.4985	0.0015	0	1.4985	0.0015		
fluid physics	deionized water	1	1	0	99.9	0.1	1	2	2	0	1.998	0.002	0	1.998	0.002		
membrane production	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	99.9	0.1	1	41	41	0	40.959	0.041	0	40.959	0.041		
premixed gas combustion	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0	0	0	99.9	0.1	1	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	99.9	0.1	1	2	2	0	279.72	0.28	0	279.72	0.28		
isoelectric focusing	deion./depyro.	15	15	0	99.9	0.1	1	4	4	0	59.94	0.06	0	59.94	0.06		
protein crystal growth	deion./depyro.	0.7	0.7	0	99.9	0.1	1	20	20	0	13.986	0.014	0	13.986	0.014		
acoustic levitator	distilled water	1	1	0	99.9	0.1	1	17	17	0	16.983	0.017	0	16.983	0.017		
alloy solidification	distilled water	2	2	0	99.9	0.1	1	15	15	0	29.97	0.03	0	29.97	0.03		
autoclave	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	99.9	0.1	1	3	3	0	1.4985	0.0015	0	1.4985	0.0015		
bulk crystal	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	99.9	0.1	1	2	2	0	1.998	0.002	0	1.998	0.002		
electrostatic levitator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	99.9	0.1	1	37	37	0	3.6963	0.0037	0	3.6963	0.0037		
free float	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	99.9	0.1	1	2	2	0	0.999	0.001	0	0.999	0.001		
variable flow shell generator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																453.7	453.7
rotating spherical convection	dielectric stud	0	0	0	99.99	0.01	0	0	0	0	0	0	0	0	0		
																0	0
isoelectric focusing	disinfectant /	0.25	0.25	0	99	1	1	4	4	0	0.99	0.01	0	0.99	0.01		
bioreactor/incubator	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	99	1	1	2	2	0	0.495	0.005	0	0.495	0.005		
high performance liquid chromatograph	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
protein crystal growth	disinfectants	0.001	0.001	0	99	1	1	20	20	0	0.0198	0.0002	0	0.0198	0.0002		
																1.52	1.52
solid surface burning	fuel	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
premixed gas	fuel	0	0	0	0	10	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0		
autoignition furnace	fuel	0	0	0.333	0.333	0.333	0	0	0	0	0	0	0	0	0		
																0	0
alloy solidificaton	GHe	700	0.12495	0	0	100	1	15	15	0	0	1.87425	0	0	10500		
acoustic levitator	GHe	2	0.000355	0	0	100	1	17	17	0	0	0.006035	0	0	34		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	1	1	0	0	0.0357	0	0	200		
EM levitator	GHe	24	0.00428	0	0	100	1	37	37	0	0	0.15836	0	0	888		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

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Waste Requirements Based on Scenario SF7

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																2.074345	11622
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	17	17	0.00034	0	0	0.00034	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	15	15	0.0003	0	0	0.0003	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	3	3	0.00006	0	0	0.00006	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	41	41	0.00082	0	0	0.00082	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.00176	0.00176
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	1	1	0	0	0.25	0	0	200		
electroepitaxy	GN2	500	0.625	0	0	100	1	2	2	0	0	1.25	0	0	1000		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	2	2	0	0	0.075	0	0	60		
gas chromatograph mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	20	20	0	0	9	0	0	7200		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																10.575	8460
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	20	20	0	0	1.0296	0	0	720		
																1.0296	720
protein crystal growth	growth syringes	5	2	100	0	0	1	20	20	40	0	0	100	0	0		
																40	100
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	20	20	0.005	0	0	0.007	0	0		
																0.005	0.007
alloy solidification	inert gas	0	0	0	0	100	1	15	15	0	0	0	0	0	0		
																0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	2	2	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1.5	30
critical point phenomena	LHe	150	15.489	0	0	69940	1	1	1	0	0	15.489	0	0	104910		
																15.489	104910
critical point phenomena	LN2	30	24.18	0	0	64560	1	1	1	0	0	24.18	0	0	19368		
freezer	LN2	0	0	0	0	64560	0	0	1	0	0	0	0	0	0		

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Waste Requirements Based on Scenario SF7

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq	% gas	equip. utili- zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
gas chromatograph - mass spectrometer	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0	24.18	19368
high performance liquid chromatograph	methonol	0	0	0	90	10	0	0	0	0	0	0	0	0	0	0	0
bioreactor/incubator	microcarrier be	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
cutting/polishing system	oil - water solu	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
water deionizer/depyrogenizer	process resin	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
protein crystal growth	protein solutio	0.02	0.02	0	99	1	1	20	20	0	0.396	0.004	0	0.396	0.004	0.4	0.4
protein crystal growth	quartz tubes	0.002	0.005	100	0	0	1	20	20	0.1	0	0	0.04	0	0	0.1	0.04
cutting/polishing system	raw material	0	0	99	0	1	0	0	0	0	0	0	0	0	0	0	0
latex reactor	reactors	2	3	100	0	0	1	4	4	12	0	0	8	0	0	12	8
protein crystal growth	reservior solut	0.00675	0.0135	0	99	1	1	20	20	0	0.2673	0.0027	0	0.13365	0.00135	0.27	0.135
general purpose hand tools	residual gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
cleaning equipment	solid waste	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0	0	0
solution crystal	solvents	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	staining soluti	0.01	0.01	0	99	1	1	2	2	0	0.0198	0.0002	0	0.0198	0.0002		
isoelectric focusing	staining soluti	0.01	0.01	0	99	1	1	4	4	0	0.0396	0.0004	0	0.0396	0.0004	0.06	0.06
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	2	2	0.01	0	0	0.02	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
solution crystal	test tubes	0	0	100	0	0	0	0	0	0	0	0	0	0	0	1.51	30.02
solution crystal	TGS solution	0	0	0.1	49.8	0.1	1	0	0	0	0	0	0	0	0	0	0
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	17	17	0.000069	0	0	0.000074	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	15	15	0.000061	0	0	0.000066	0	0		
autoignition furnace	wipes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000013	0	0		
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		

Waste Requirements Based on Scenario SF7

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
float zone	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000013	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	41	41	0.000167	0	0	0.000180	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000456	0.000492
								Totals		55.25781	513.3632	63.90766	168.1832	510.2375	151926.8	632.5286	152605.2

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Consumables Based on Scenario SF8 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz- ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material

Consumables Based on Scenario SF8 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz- ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
high performance liquid chromatograph	acetonitrile	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
										0	0	0	0	0	0	0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
acoustic levitator	air	10	0.01312	0	0	100	1	20	20	0	0	0.2624	0	0	200		
alloy solidification	air	200	0.256	0	0	100	1	16	16	0	0	4.096	0	0	3200		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	4	4	0	0	0.224	0	0	180		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	2	2	0	0	0.00512	0	0	4		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	44	44	0	0	1.35168	0	0	1056		
float zone	air	5	0.005973	0	0	100	1	3	3	0	0	0.01792	0	0	15		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	6	6	0	0	0.43209	0	0	336		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		6.38921	4991
acoustic levitator	Ar	41	0.052726	0	0	100	1	20	20	0	0	1.05452	0	0	820		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	4	4	0	0	0.3115	0	0	180		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	1056		
EM levitator	Ar	24	0.04272	0	0	100	1	44	44	0	0	1.87968	0	0	42		
float zone	Ar	14	0.02492	0	0	100	1	3	3	0	0	0.07476	0	0	0		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	Ar	0	0	0	0	100	0	0	0	0	0	2.5632	0	0	1440		
protein crystal growth	Ar	36	0.06408	0	0	100	1	40	40	0	0	0	0	0	0		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	Ar	0	0	0	0	100	0	0	0	0	0	0.2136	0	0	120		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	6	6	0	0		0	0			
													0	0		6.09726	3658
acoustic levitator	cleaning fluid	1	1	0	100	0	1	20	20	0	20	0	0	20	0		

Consumables Based on Scenario SF8 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
alloy solidification	cleaning fluid	1	1	0	100	0	1	16	16	0	16	0	0	16	0		
atmospheric microphysics	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	100	0	1	4	4	0	2	0	0	2	0		
bulk crystal	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	100	0	1	1	1	0	1	0	0	1	0		
droplet/spray burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	100	0	1	44	44	0	0.44	0	0	0.44	0		
float zone	cleaning fluid	0.1	0.1	0	100	0	1	3	3	0	0.3	0	0	0.3	0		
fluid physics	cleaning fluid	0.1	0.1	0	100	0	1	0	0	0	0	0	0	0	0		
free float	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	100	0	1	64	64	0	0.64	0	0	0.64	0		
premixed gas combustion	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	100	0	1	6	6	0	0.06	0	0	0.06	0		
variable flow shell generator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		40.44	40.44
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
atmospheric microphysics	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	100	0	1	3	3	0	1.5	0	0	1.5	0		
fluid physics	deionized water	1	1	0	100	0	1	2	2	0	2	0	0	2	0		
membrane production	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	100	0	1	64	64	0	64	0	0	64	0		
premixed gas combustion	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0.5	0.5	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	100	0	1	2	2	0	280	0	0	280	0		
isoelectric focusing	deion./depyro.	15	15	0	100	0	1	4	4	0	60	0	0	60	0		
protein crystal growth	deion./depyro.	0.7	0.7	0	100	0	1	40	40	0	28	0	0	28	0		
acoustic levitator	distilled water	1	1	0	100	0	1	20	20	0	20	0	0	20	0		
alloy solidification	distilled water	2	2	0	100	0	1	16	16	0	32	0	0	32	0		
autoclave	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	100	0	1	4	4	0	2	0	0	2	0		
bulk crystal	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	100	0	1	2	2	0	2	0	0	2	0		

Consumables Based on Scenario SF8 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
electrostatic levitator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	100	0	1	44	44	0	4.4	0	0	4.4	0		
free float	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	100	0	1	0	0	0	0	0	0	0	0		
variable flow shell generator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																495.9	495.9
electroepitaxy	GH2	250	0.0225	0	0	100	1	2	2	0	0	0.045	0	0	500		
													0	0		0.045	500
acoustic levitator	GHe	2	0.000355	0	0	100	1	20	20	0	0	0.0071	0	0	40		
alloy solidification	GHe	700	0.12495	0	0	100	1	16	16	0	0	1.9992	0	0	11200		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	1	1	0	0	0.0357	0	0	200		
droplet/spray burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	44	44	0	0	0.18832	0	0	1056		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		2.23032	12496
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	20	20	0.0004	0	0	0.0004	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	16	16	0.00032	0	0	0.00032	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	64	64	0.00128	0	0	0.00128	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	6	6	0.00012	0	0	0.00012	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.0024	0.0024
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	1	1	0	0	0.25	0	0	200		
droplet/spray burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	2	2	0	0	1.25	0	0	1000		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	2	2	0	0	0.075	0	0	60		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

Consumables Based on Scenario SF8 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
premixed gas combustion	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	40	40	0	0	18	0	0	14400		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		19.575	15660
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	40	40	0	0	2.0592	0	0	1440		
solid surface burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		2.0592	1440
alloy solidification	inert gas	0	0	0	0	100	1	16	16	0	0	0	0	0	0		
													0	0		0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	2	2	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		1.5	30
critical point phenomena	LHe	150	28.75	0	100	0	1	1	1	0	28.75	0	0	150	0		
													0	0		28.75	150
critical point phenomena	LN2	30	24.18	0	100	0	1	1	1	0	24.18	0	0	30	0		
freezer	LN2	0	0	0	100	0	0	0	1	0	0	0	0	0	0		
gas chromatograph - mass spectrometer	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		24.18	30
high performance liquid chromatograph	methenol	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
cutting/polishing system	oil- water solu	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
water deionizer/depyrogenizer	process resin	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
solution crystal	solvents	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	2	2	0.01	0	0	0.02	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
solution crystal	test tubes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
													0	0		1.51	30.02
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	16	16	0.000065	0	0	0.000070	0	0		
autoignition furnace	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		

Consumables Based on Scenario SF8 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
float zone	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000012	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	64	64	0.000261	0	0	0.000281	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	40	40	0.000163	0	0	0.000176	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	6	6	0.000024	0	0	0.000026	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000669	0.000720
									Totals	3.013069	589.27	36.39599	60.02312	716.34	38745	628.6790	39521.36

Samples Based on Scenario SFB

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
solid surface burning	fuel - solid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	burn catalytic	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel, liquid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	fuel - gaseous	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	2	2	0	10	0	0	10	0		
isoelectric focusing	raw material	0.1	0.15	0	100	0	1	4	4	0	0.6	0	0	0.4	0		
organic & polymer crystal growth	buffer solution	34.4025	34.4025	0	100	0	1	64	64	0	2201.76	0	0	2201.76	0		
bioreactor/incubator	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	staining soluti	0.01	0.01	0	100	0	1	4	4	0	0.04	0	0	0.04	0		
continuous flow electrophoresis	raw material	0.3	0.4	0	100	0	1	2	2	0	0.8	0	0	0.6	0		
contact angle measurement unit	test fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	TGS solution	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	seed crystals	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
fluid physics	TGS solution	2	3.36	0	100	0	1	2	2	0	6.72	0	0	4	0		
protein crystal growth	reservior solut	0.00675	0.0135	0	100	0	1	40	40	0	0.54	0	0	0.27	0		
etching equipment	etchant solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
atmospheric microphysics	acid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	monomer/polymer	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
latex reactor	AMBN process in	0.25	0.2275	0	100	0	1	4	4	0	0.91	0	0	1	0		
latex reactor	styrene	0.75	0.6825	0	100	0	1	4	4	0	2.73	0	0	3	0		
continuous flow electrophoresis	staining soluti	0.01	0.01	0	100	0	1	2	2	0	0.02	0	0	0.02	0		
continuous flow electrophoresis	buffer solution	2.7	3.5	0	100	0	1	2	2	0	7	0	0	5.4	0		
isoelectric focusing	acid	0.3	0.375	0	100	0	1	4	4	0	1.5	0	0	1.2	0		
solution crystal	crystal solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	seed crystal	0.002	0.00164	0	100	0	1	2	2	0	0.00328	0	0	0.004	0		
rotating spherical convection	dielectric stud	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	protein solutio	0.02	0.02	0	100	0	1	40	40	0	0.8	0	0	0.8	0		
bulk crystal	liquid phase en	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	100	0	1	2	2	0	0.5	0	0	0.5	0		
bioreactor/incubator	raw material	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	disinfectant /	0.25	0.25	0	100	0	1	4	4	0	1	0	0	1	0		
isoelectric focusing	calibration sol	0.3	0.3	0	100	0	1	4	4	0	1.2	0	0	1.2	0		
protein crystal growth	disinfectants	0.001	0.001	0	100	0	1	40	40	0	0.04	0	0	0.04	0		
isoelectric focusing	amphoylte conce	0.15	0.3	0	100	0	1	4	4	0	1.2	0	0	0.6	0		
latex reactor	latex solutions	1	0.91	0	100	0	1	4	4	0	3.64	0	0	4	0		
membrane production	catalyst soluti	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	basic solution	0.3	0.435	0	100	0	1	4	4	0	1.74	0	0	1.2	0		
high performance liquid chromatograph	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																2242.743	2237.034
autoignition furnace	fuel sample - s	0	0	33.3	33.3	33.3	0	0	0	0	0	0	0	0	0		
																0	0
electroepitaxy	III-V group sou	2	11	50	50	0	1	2	2	11	11	0	2	2	0		
																22	4
free float	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	microcarrier be	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
float zone	raw material	0.1288	0.966	100	0	0	1	3	3	2.898	0	0	0.3864	0	0		
organic & polymer crystal growth	acetonitrile	33.36	36.696	100	0	0	1	64	64	2348.544	0	0	2135.04	0	0		
acoustic levitator	raw material	0.1	0.6	100	0	0	1	20	20	12	0	0	2	0	0		
organic & polymer crystal growth	polydiacetylene	0.1288	0.2576	100	0	0	1	64	64	16.4864	0	0	8.2432	0	0		

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Samples Based on Scenario SF8

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
EM levitator	raw material	0.00177	0.033	100	0	0	1	44	44	1.452	0	0	0.07788	0	0		
optical fiber pulling	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
alloy solidification	raw material	0.66	4.93284	100	0	0	1	16	16	78.92544	0	0	10.56	0	0		
latex reactor	reactors	2	3	100	0	0	1	4	4	12	0	0	8	0	0		
electrostatic levitator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	40	40	0.2	0	0	0.08	0	0		
cleaning equipment	solid waste	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, large	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bulk crystal	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	semiconductor o	0.2	1.8	100	0	0	1	6	6	10.8	0	0	1.2	0	0		
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	40	40	0.01	0	0	0.014	0	0		
protein crystal growth	growth syringes	5	2	100	0	0	1	40	40	80	0	0	200	0	0		
water deionizer/depyrogenizer	filter cartridg	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	naphthalene	1.0425	1.0425	100	0	0	1	64	64	66.72	0	0	66.72	0	0		
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	sample material	0.315	2.523	100	0	0	1	4	4	10.092	0	0	1.26	0	0		
cutting/polishing system	encapsulant mat	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																2640.127	2433.581
								Totals		2651.127	2253.743	0	2435.581	2239.034	0	4904.871	4674.615

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Waste Requirements Based on Scenario SF8

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili- zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
high performance liquid chromatograph	acetonitrile	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
atmospheric microphysics	acid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
isoelectric focusing	acid	0.3	0.375	0	99	1	1	4	4	0	1.485	0.015	0	1.188	0.012		
																1.5	1.2
acoustic levitator	air	10	0.01312	0	0	100	1	20	20	0	0	0.2624	0	0	200		
alloy solidification	air	200	0.256	0	0	100	1	16	16	0	0	4.096	0	0	3200		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	4	4	0	0	0.224	0	0	180		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	2	2	0	0	0.00512	0	0	4		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	44	44	0	0	1.35168	0	0	1056		
float zone	air	5	0.005973	0	0	100	1	3	3	0	0	0.01792	0	0	15		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	6	6	0	0	0.43209	0	0	336		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																6.38921	4991
isoelectric focusing	amphoylte conce	0.15	0.3	0	99	1	1	4	4	0	1.188	0.012	0	0.594	0.006		
																1.2	0.6
bridgman, large	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	ampoule fragmen	0.001	0.0001	100	0	0	1	4	6	0.0006	0	0	0.006	0	0		
bulk crystal	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.0006	0.006
acoustic levitator	Ar	41	0.052726	0	0	100	1	20	20	0	0	1.05452	0	0	820		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	4	4	0	0	0.3115	0	0	180		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	44	44	0	0	1.87968	0	0	1056		
float zone	Ar	14	0.02492	0	0	100	1	3	3	0	0	0.07476	0	0	42		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	40	40	0	0	2.5632	0	0	1440		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	6	6	0	0	0.2136	0	0	120		
																6.09726	3658
isoelectric focusing	basic solution	0.3	0.435	0	99	1	1	4	4	0	1.7226	0.0174	0	1.188	0.012		

Waste Requirements Based on Scenario SF8

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
																1.74	1.2
UV sterilization unit	biological wast	0	0	89.98	10	0.01	0	0	0	0	0	0	0	0	0	0	0
cutting/polishing system	boule fragments	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	buffer solution	2.7	3.5	2	97.9	0.1	1	2	2	0.14	6.853	0.007	0.108	5.2866	0.0054	7	5.4
isoelectric focusing	calibration sol	0.3	0.3	0	99.9	0.1	1	4	4	0	1.1988	0.0012	0	1.1988	0.0012	1.2	1.2
membrane production	catalyst soluti	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
acoustic levitator	cleaning fluid	1	1	0	99	1	1	20	20	0	19.8	0.2	0	19.8	0.2		
alloy solidification	cleaning fluid	1	1	0	99	1	1	16	16	0	15.84	0.16	0	15.84	0.16		
atmospheric microphysics	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	99	1	1	4	4	0	1.98	0.02	0	1.98	0.02		
bulk crystal	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	99	1	1	1	1	0	0.99	0.01	0	0.99	0.01		
droplet/spray burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	99	1	1	44	44	0	0.4356	0.0044	0	0.4356	0.0044		
float zone	cleaning fluid	0.1	0.1	0	99	1	1	3	3	0	0.297	0.003	0	0.297	0.003		
fluid physics	cleaning fluid	0.1	0.1	0	99	1	1	2	2	0	0.198	0.002	0	0.198	0.002		
free float	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	99	1	1	64	64	0	0.6336	0.0064	0	0.6336	0.0064		
premixed gas combustion	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	99	1	1	6	6	0	0.0594	0.0006	0	0.0594	0.0006		
variable flow shell generator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0	40.64	40.64
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
autoignition furnace	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
droplet/spray burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
premixed gas combustion	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
solid surface burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0	0	0
critical point phenomena	cryogen	0	0	0	0	64560	1	1	1	0	0	0	0	0	0	0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	2	2	0	10	0	0	10	0	10	10
atmospheric microphysics	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF8

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
autoignition furnace	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	99.9	0.1	1	3	3	0	1.4985	0.0015	0	1.4985	0.0015		
fluid physics	deionized water	1	1	0	99.9	0.1	1	2	2	0	1.998	0.002	0	1.998	0.002		
membrane production	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	99.9	0.1	1	64	64	0	63.936	0.064	0	63.936	0.064		
premixed gas combustion	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0	0	0	99.9	0.1	1	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	99.9	0.1	1	2	2	0	279.72	0.28	0	279.72	0.28		
isoelectric focusing	deion./depyro.	15	15	0	99.9	0.1	1	4	4	0	59.94	0.06	0	59.94	0.06		
protein crystal growth	deion./depyro.	0.7	0.7	0	99.9	0.1	1	40	40	0	27.972	0.028	0	27.972	0.028		
acoustic levitator	distilled water	1	1	0	99.9	0.1	1	20	20	0	19.98	0.02	0	19.98	0.02		
alloy solidification	distilled water	2	2	0	99.9	0.1	1	16	16	0	31.968	0.032	0	31.968	0.032		
autoclave	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	99.9	0.1	1	4	4	0	1.998	0.002	0	1.998	0.002		
bulk crystal	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	99.9	0.1	1	2	2	0	1.998	0.002	0	1.998	0.002		
electrostatic levitator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	99.9	0.1	1	44	44	0	4.3956	0.0044	0	4.3956	0.0044		
free float	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	99.9	0.1	1	6	6	0	2.997	0.003	0	2.997	0.003		
variable flow shell generator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																498.9	498.9
rotating spherical convection	dielectric stud	0	0	0	99.99	0.01	0	0	0	0	0	0	0	0	0		
																0	0
isoelectric focusing	disinfectant /	0.25	0.25	0	99	1	1	4	4	0	0.99	0.01	0	0.99	0.01		
bioreactor/incubator	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	99	1	1	2	2	0	0.495	0.005	0	0.495	0.005		
high performance liquid chromatograph	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
protein crystal growth	disinfectants	0.001	0.001	0	99	1	1	40	40	0	0.0396	0.0004	0	0.0396	0.0004		
																1.54	1.54
solid surface burning	fuel	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
premixed gas	fuel	0	0	0	0	10	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0		
autoignition furnace	fuel	0	0	0.333	0.333	0.333	0	0	0	0	0	0	0	0	0		
																0	0
alloy solidificaton	GHe	700	0.12495	0	0	100	1	16	16	0	0	1.9992	0	0	11200		
acoustic levitator	GHe	2	0.000355	0	0	100	1	20	20	0	0	0.0071	0	0	40		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	1	1	0	0	0.0357	0	0	200		
EM levitator	GHe	24	0.00428	0	0	100	1	44	44	0	0	0.18832	0	0	1056		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF8

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																2.23032	12496
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	20	20	0.0004	0	0	0.0004	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	16	16	0.00032	0	0	0.00032	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	64	64	0.00128	0	0	0.00128	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	6	6	0.00012	0	0	0.00012	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.0024	0.0024
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	1	1	0	0	0.25	0	0	200		
electroepitaxy	GN2	500	0.625	0	0	100	1	2	2	0	0	1.25	0	0	1000		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	2	2	0	0	0.075	0	0	60		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	40	40	0	0	18	0	0	14400		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																19.575	15660
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	40	40	0	0	2.0592	0	0	1440		
																2.0592	1440
protein crystal growth	growth syringes	5	2	100	0	0	1	40	40	80	0	0	200	0	0		
																80	200
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	40	40	0.01	0	0	0.014	0	0		
																0.01	0.014
alloy solidification	inert gas	0	0	0	0	100	1	16	16	0	0	0	0	0	0		
																0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	2	2	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1.5	30
critical point phenomena	LHe	150	15.489	0	0	69940	1	1	1	0	0	15.489	0	0	104910		
																15.489	104910
critical point phenomena	LN2	30	24.18	0	0	64560	1	1	1	0	0	24.18	0	0	19368		
freezer	LN2	0	0	0	0	64560	0	0	1	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF8

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
gas chromatograph - mass spectrometer	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
																24.18	19368
high performance liquid chromatograph	methonol	0	0	0	90	10	0	0	0	0	0	0	0	0	0		
																0	0
bioreactor/incubator	microcarrier be	0	0	99	1	0	0	0	0	0	0	0	0	0	0		
																0	0
cutting/polishing system	oil- water solu	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
water deionizer/depyrogenizer	process resin	0	0	99	1	0	0	0	0	0	0	0	0	0	0		
																0	0
protein crystal growth	protein solutio	0.02	0.02	0	99	1	1	40	40	0	0.792	0.008	0	0.792	0.008		
																0.8	0.8
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	40	40	0.2	0	0	0.08	0	0		
																0.2	0.08
cutting/polishing system	raw material	0	0	99	0	1	0	0	0	0	0	0	0	0	0		
																0	0
latex reactor	reactors	2	3	100	0	0	1	4	4	12	0	0	8	0	0		
																12	8
protein crystal growth	reservior solut	0.00675	0.0135	0	99	1	1	40	40	0	0.5346	0.0054	0	0.2673	0.0027		
																0.54	0.27
general purpose hand tools	residual gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
cleaning equipment	solid waste	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0		
																0	0
solution crystal	solvents	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	staining soluti	0.01	0.01	0	99	1	1	2	2	0	0.0198	0.0002	0	0.0198	0.0002		
isoelectric focusing	staining soluti	0.01	0.01	0	99	1	1	4	4	0	0.0396	0.0004	0	0.0396	0.0004		
																0.06	0.06
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	2	2	0.01	0	0	0.02	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	2	2	1.5	0	0	30	0	0		
solution crystal	test tubes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1.51	30.02
solution crystal	TGS solution	0	0	0.1	49.8	0.1	1	0	0	0	0	0	0	0	0		
																0	0
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	16	16	0.000065	0	0	0.000070	0	0		
autoignition furnace	wipes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		

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Waste Requirements Based on Scenario SF8

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
float zone	wipes	0.000004	0.000004	100	0	0	1	3	3	0.000012	0	0	0.000013	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	64	64	0.000261	0	0	0.000281	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	40	40	0.000163	0	0	0.000176	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	6	6	0.000024	0	0	0.000026	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000669	0.000721
								Totals		95.36366	563.9927	77.00729	268.2311	560.7334	162523.9	736.3636	163352.9

Consumables Based on Scenario SF9 Mission

Facility/ Equipment | Material | Volume per run liters | mass kilogram | % solid | % liq | % gas | equip utiliz-ation | run per facility | runs per mission | solid mass kg | liquid mass kg | gas mass kg | solid volume liter | liquid volume liter | gas volume liter | total mass for material | total volume fo material

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
high performance liquid chromatograph	acetonitrile	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
										0	0	0	0	0	0	0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
acoustic levitator	air	10	0.01312	0	0	100	1	36	36	0	0	0.47232	0	0	360		
alloy solidification	air	200	0.256	0	0	100	1	12	12	0	0	3.072	0	0	2400		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	4	4	0	0	0.224	0	0	180		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	1	1	0	0	0.00256	0	0	2		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	36	36	0	0	1.10592	0	0	864		
float zone	air	5	0.005973	0	0	100	1	10	10	0	0	0.059733	0	0	50		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	4	4	0	0	0.28806	0	0	224		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		5.224593	4080
acoustic levitator	Ar	41	0.052726	0	0	100	1	36	36	0	0	1.898136	0	0	1476		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	4	4	0	0	0.3115	0	0	180		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	36	36	0	0	1.53792	0	0	864		
float zone	Ar	14	0.02492	0	0	100	1	10	10	0	0	0.2492	0	0	140		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	20	20	0	0	1.2816	0	0	720		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	4	4	0	0	0.1424	0	0	80		
													0	0		5.420756	3460
acoustic levitator	cleaning fluid	1	1	0	100	0	1	36	36	0	36	0	0	36	0		

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Consumables Based on Scenario SF9 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
alloy solidification	cleaning fluid	1	1	0	100	0	1	12	12	0	12	0	0	12	0		
atmospheric microphysics	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	100	0	1	4	4	0	2	0	0	2	0		
bulk crystal	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	100	0	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	100	0	1	36	36	0	0.36	0	0	0.36	0		
float zone	cleaning fluid	0.1	0.1	0	100	0	1	10	10	0	1	0	0	1	0		
fluid physics	cleaning fluid	0.1	0.1	0	100	0	1	0	0	0	0	0	0	0	0		
free float	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	100	0	1	27	27	0	0.27	0	0	0.27	0		
premixed gas combustion	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	100	0	1	4	4	0	0.04	0	0	0.04	0		
variable flow shell generator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0	51.67	51.67
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
atmospheric microphysics	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0
autoignition furnace	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	100	0	1	10	10	0	5	0	0	5	0		
fluid physics	deionized water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		
membrane production	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	100	0	1	27	27	0	27	0	0	27	0		
premixed gas combustion	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0.5	0.5	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	100	0	1	1	1	0	140	0	0	140	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	100	0	1	2	2	0	30	0	0	30	0		
isoelectric focusing	deion./depyro.	15	15	0	100	0	1	20	20	0	14	0	0	14	0		
protein crystal growth	deion./depyro.	0.7	0.7	0	100	0	1	36	36	0	36	0	0	36	0		
acoustic levitator	distilled water	1	1	0	100	0	1	12	12	0	24	0	0	24	0		
alloy solidification	distilled water	2	2	0	100	0	0	0	0	0	0	0	0	0	0		
autoclave	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	100	0	1	4	4	0	2	0	0	2	0		
bulk crystal	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		

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Consumables Based on Srenario SF9 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
electrostatic levitator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	100	0	1	36	36	0	3.6	0	0	3.6	0		
free float	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	100	0	1	0	0	0	0	0	0	0	0		
variable flow shell generator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																283.6	283.6
electroepitaxy	GH2	250	0.0225	0	0	100	1	1	1	0	0	0.0225	0	0	250		
													0	0		0.0225	250
acoustic levitator	GHe	2	0.000355	0	0	100	1	36	36	0	0	0.01278	0	0	72		
alloy solidification	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.66626	9336
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	36	36	0.00072	0	0	0.00072	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	27	27	0.00054	0	0	0.00054	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.00176	0.00176
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

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Consumables Based on Scenario SF9 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
premixed gas combustion	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	20	20	0	0	9	0	0	7200		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		9.6625	7730
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	20	20	0	0	1.0296	0	0	720		
solid surface burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.0296	720
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0		
													0	0		0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.75	15
critical point phenomena	LHe	150	28.75	0	100	0	1	0	0	0	0	0	0	0	0		
													0	0		0	0
critical point phenomena	LN2	30	24.18	0	100	0	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	100	0	0	0	1	0	0	0	0	0	0		
gas chromatograph - mass spectrometer	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
high performance liquid chromatograph	methanol	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
cutting/polishing system	oil- water solu	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
water deionizer/depyrogenizer	process resin	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
solution crystal	solvents	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
													0	0		0.755	15.01
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	36	36	0.000146	0	0	0.000158	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000048	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		

Consumables Based on Scenario SF9 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
float zone	wipes	0.000004	0.000004	100	0	0	1	10	10	0.000040	0	0	0.00004	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	27	27	0.000110	0	0	0.000118	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000481	0.000515
									Totals	1.507241	335.27	23.02620	30.01227	335.27	25576	359.8034	25941.28

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Samples Based on Scenario SF9

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
solid surface burning	fuel - solid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	burn catalytic	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel, liquid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	fuel - gaseous	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0		
isoelectric focusing	raw material	0.1	0.15	0	100	0	1	2	2	0	0.3	0	0	0.2	0		
organic & polymer crystal growth	buffer solution	34.4025	34.4025	0	100	0	1	27	27	0	928.8675	0	0	928.8675	0		
bioreactor/incubator	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	staining soluti	0.01	0.01	0	100	0	1	2	2	0	0.02	0	0	0.02	0		
continuous flow electrophoresis	raw material	0.3	0.4	0	100	0	1	1	1	0	0.4	0	0	0.3	0		
contact angle measurement unit	test fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	TGS solution	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	seed crystals	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
fluid physics	TGS solution	2	3.36	0	100	0	1	1	1	0	3.36	0	0	2	0		
protein crystal growth	reservior solut	0.00675	0.0135	0	100	0	1	20	20	0	0.27	0	0	0.135	0		
etching equipment	etchant solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
atmospheric microphysics	acid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	monomer/polymer	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
latex reactor	AMBN process in	0.25	0.2275	0	100	0	1	2	2	0	0.455	0	0	0.5	0		
latex reactor	styrene	0.75	0.6825	0	100	0	1	2	2	0	1.365	0	0	1.5	0		
continuous flow electrophoresis	staining soluti	0.01	0.01	0	100	0	1	1	1	0	0.01	0	0	0.01	0		
continuous flow electrophoresis	buffer solution	2.7	3.5	0	100	0	1	1	1	0	3.5	0	0	2.7	0		
isoelectric focusing	acid	0.3	0.375	0	100	0	1	2	2	0	0.75	0	0	0.6	0		
solution crystal	crystal solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	seed crystal	0.002	0.00164	0	100	0	1	1	1	0	0.00164	0	0	0.002	0		
rotating spherical convection	dielectric stud	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	protein solutio	0.02	0.02	0	100	0	1	20	20	0	0.4	0	0	0.4	0		
bulk crystal	liquid phase en	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	100	0	1	1	1	0	0.25	0	0	0.25	0		
bioreactor/incubator	raw material	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	disinfectant /	0.25	0.25	0	100	0	1	2	2	0	0.5	0	0	0.5	0		
isoelectric focusing	calibration sol	0.3	0.3	0	100	0	1	2	2	0	0.6	0	0	0.6	0		
protein crystal growth	disinfectants	0.001	0.001	0	100	0	1	20	20	0	0.02	0	0	0.02	0		
isoelectric focusing	amphoylte conce	0.15	0.3	0	100	0	1	2	2	0	0.6	0	0	0.3	0		
latex reactor	latex solutions	1	0.91	0	100	0	1	2	2	0	1.82	0	0	2	0		
membrane production	catalyst soluti	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	basic solution	0.3	0.435	0	100	0	1	2	2	0	0.87	0	0	0.6	0		
high performance liquid chromatograph	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																949.3591	946.5045
autoignition furnace	fuel sample - s	0	0	33.3	33.3	33.3	0	0	0	0	0	0	0	0	0		
																0	0
electroepitaxy	III-V group sou	2	11	50	50	0	1	1	1	5.5	5.5	0	1	1	0		
																11	2
free float	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	microcarrier be	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
float zone	raw material	0.1288	0.966	100	0	0	1	10	10	9.66	0	0	1.288	0	0		
organic & polymer crystal growth	acetonitrile	33.36	36.696	100	0	0	1	27	27	990.792	0	0	900.72	0	0		
acoustic levitator	raw material	0.1	0.6	100	0	0	1	36	36	21.6	0	0	3.6	0	0		
organic & polymer crystal growth	polydiacetylene	0.1288	0.2576	100	0	0	1	27	27	6.9552	0	0	3.4776	0	0		

Samples Based on Scenario SF9

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
EM levitator	raw material	0.00177	0.033	100	0	0	1	36	36	1.188	0	0	0.06372	0	0		
optical fiber pulling	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
alloy solidification	raw material	0.66	4.93284	100	0	0	1	12	12	59.19408	0	0	7.92	0	0		
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0		
electrostatic levitator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	20	20	0.1	0	0	0.04	0	0		
cleaning equipment	solid waste	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, large	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bulk crystal	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	semiconductor o	0.2	1.8	100	0	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	4	4	7.2	0	0	0.8	0	0		
protein crystal growth	growth syringes	5	2	100	0	0	1	20	20	0.005	0	0	0.007	0	0		
water deionizer/depyrogenizer	filter cartridg	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	naphthalene	1.0425	1.0425	100	0	0	1	27	27	28.1475	0	0	28.1475	0	0		
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	sample material	0.315	2.523	100	0	0	1	4	4	10.092	0	0	1.26	0	0		
cutting/polishing system	encapsulant mat	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1180.933	1051.323
								Totals		1186.433	954.8591	0	1052.323	947.5045	0	2141.292	1999.828

Waste Requirements Based on Scenario SF9

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
high performance liquid chromatograph	acetonitrile	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
atmospheric microphysics	acid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
isoelectric focusing	acid	0.3	0.375	0	99	1	1	2	2	0	0.7425	0.0075	0	0.594	0.006		
																0.75	0.6
acoustic levitator	air	10	0.01312	0	0	100	1	36	36	0	0	0.47232	0	0	360		
alloy solidification	air	200	0.256	0	0	100	1	12	12	0	0	3.072	0	0	2400		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	4	4	0	0	0.224	0	0	180		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	1	1	0	0	0.00256	0	0	2		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	36	36	0	0	1.10592	0	0	864		
float zone	air	5	0.005973	0	0	100	1	10	10	0	0	0.059733	0	0	50		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	4	4	0	0	0.28806	0	0	224		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																5.224593	4080
isoelectric focusing	amphoylte conce	0.15	0.3	0	99	1	1	2	2	0	0.594	0.006	0	0.297	0.003		
																0.6	0.3
bridgman, large	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	ampoule fragmen	0.001	0.0001	100	0	0	1	4	6	0.0006	0	0	0.006	0	0		
bulk crystal	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.0006	0.006
acoustic levitator	Ar	41	0.052726	0	0	100	1	36	36	0	0	1.898136	0	0	1476		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	4	4	0	0	0.3115	0	0	180		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	36	36	0	0	1.53792	0	0	864		
float zone	Ar	14	0.02492	0	0	100	1	10	10	0	0	0.2492	0	0	140		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	20	20	0	0	1.2816	0	0	720		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	4	4	0	0	0.1424	0	0	80		
																5.420756	3460
isoelectric focusing	basic solution	0.3	0.435	0	99	1	1	2	2	0	0.8613	0.0087	0	0.594	0.006		

Waste Requirements Based on Scenario SF9

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
																0.87	0.6
UV sterilization unit	biological wast	0	0	89.98	10	0.01	0	0	0	0	0	0	0	0	0		
																0	0
cutting/polishing system	boule fragments	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	buffer solution	2.7	3.5	2	97.9	0.1	1	1	1	0.07	3.4265	0.0035	0.054	2.6433	0.0027		
																3.5	2.7
isoelectric focusing	calibration sol	0.3	0.3	0	99.9	0.1	1	2	2	0	0.5994	0.0006	0	0.5994	0.0006		
																0.6	0.6
membrane production	catalyst soluti	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																0	0
acoustic levitator	cleaning fluid	1	1	0	99	1	1	36	36	0	35.64	0.36	0	35.64	0.36		
alloy solidification	cleaning fluid	1	1	0	99	1	1	12	12	0	11.88	0.12	0	11.88	0.12		
atmospheric microphysics	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	99	1	1	4	4	0	1.98	0.02	0	1.98	0.02		
bulk crystal	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	99	1	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	99	1	1	36	36	0	0.3564	0.0036	0	0.3564	0.0036		
float zone	cleaning fluid	0.1	0.1	0	99	1	1	10	10	0	0.99	0.01	0	0.99	0.01		
fluid physics	cleaning fluid	0.1	0.1	0	99	1	1	1	1	0	0.099	0.001	0	0.099	0.001		
free float	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	99	1	1	27	27	0	0.2673	0.0027	0	0.2673	0.0027		
premixed gas combustion	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	99	1	1	4	4	0	0.0396	0.0004	0	0.0396	0.0004		
variable flow shell generator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																51.77	51.77
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
autoignition furnace	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
droplet/spray burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
premixed gas combustion	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
solid surface burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
																0	0
critical point phenomena	cryogen	0	0	0	0	64560	1	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0		
																5	5
atmospheric microphysics	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		

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Waste Requirements Based on Scenario SF9

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
autoignition furnace	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	99.9	0.1	1	10	10	0	4.995	0.005	0	4.995	0.005		
fluid physics	deionized water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
membrane production	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	99.9	0.1	1	27	27	0	26.973	0.027	0	26.973	0.027		
premixed gas combustion	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0	0	0	99.9	0.1	1	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	99.9	0.1	1	1	1	0	139.86	0.14	0	139.86	0.14		
isoelectric focusing	deion./depyro.	15	15	0	99.9	0.1	1	2	2	0	29.97	0.03	0	29.97	0.03		
protein crystal growth	deion./depyro.	0.7	0.7	0	99.9	0.1	1	20	20	0	13.986	0.014	0	13.986	0.014		
acoustic levitator	distilled water	1	1	0	99.9	0.1	1	36	36	0	35.964	0.036	0	35.964	0.036		
alloy solidification	distilled water	2	2	0	99.9	0.1	1	12	12	0	23.976	0.024	0	23.976	0.024		
autoclave	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	99.9	0.1	1	4	4	0	1.998	0.002	0	1.998	0.002		
bulk crystal	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
electrostatic levitator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	99.9	0.1	1	36	36	0	3.5964	0.0036	0	3.5964	0.0036		
free float	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	99.9	0.1	1	4	4	0	1.998	0.002	0	1.998	0.002		
variable flow shell generator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																285.6	285.6
rotating spherical convection	dielectric stud	0	0	0	99.99	0.01	0	0	0	0	0	0	0	0	0		
																0	0
isoelectric focusing	disinfectant /	0.25	0.25	0	99	1	1	2	2	0	0.495	0.005	0	0.495	0.005		
bioreactor/incubator	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	99	1	1	1	1	0	0.2475	0.0025	0	0.2475	0.0025		
high performance liquid chromatograph	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
protein crystal growth	disinfectants	0.001	0.001	0	99	1	1	20	20	0	0.0198	0.0002	0	0.0198	0.0002		
																0.77	0.77
solid surface burning	fuel	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
premixed gas	fuel	0	0	0	0	10	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0		
autoignition furnace	fuel	0	0	0.333	0.333	0.333	0	0	0	0	0	0	0	0	0		
																0	0
alloy solidificaton	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
acoustic levitator	GHe	2	0.000355	0	0	100	1	36	36	0	0	0.01278	0	0	72		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF9

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0	1.66626	9336
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	36	36	0.00072	0	0	0.00072	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	27	27	0.00054	0	0	0.00054	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.00176	0.00176
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	20	20	0	0	9	0	0	7200		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0	9.6625	7730
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	20	20	0	0	1.0296	0	0	720	1.0296	720
protein crystal growth	growth syringes	5	2	100	0	0	1	20	20	40	0	0	100	0	0	40	100
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	20	20	0.005	0	0	0.007	0	0	0.005	0.007
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0	0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.75	15
critical point phenomena	LHe	150	15.489	0	0	69940	1	0	0	0	0	0	0	0	0	0	0
critical point phenomena	LN2	30	24.18	0	0	64560	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	0	64560	0	0	1	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF9

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
gas chromatograph - mass spectrometer	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0	0	0
high performance liquid chromatograph	methonol	0	0	0	90	10	0	0	0	0	0	0	0	0	0	0	0
bioreactor/incubator	microcarrier be	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
cutting/polishing system	oil- water solu	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
water deionizer/depyrogenizer	process resin	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
protein crystal growth	protein solutio	0.02	0.02	0	99	1	1	20	20	0	0.396	0.004	0	0.396	0.004	0.4	0.4
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	20	20	0.1	0	0	0.04	0	0	0.1	0.04
cutting/polishing system	raw material	0	0	99	0	1	0	0	0	0	0	0	0	0	0	0	0
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0	6	4
protein crystal growth	reservior solut	0.00675	0.0135	0	99	1	1	20	20	0	0.2673	0.0027	0	0.13365	0.00135	0.27	0.135
general purpose hand tools	residual gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
cleaning equipment	solid waste	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0	0	0
solution crystal	solvents	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	staining soluti	0.01	0.01	0	99	1	1	1	1	0	0.0099	0.0001	0	0.0099	0.0001		
isoelectric focusing	staining soluti	0.01	0.01	0	99	1	1	2	2	0	0.0198	0.0002	0	0.0198	0.0002	0.03	0.03
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.755	15.01
solution crystal	TGS solution	0	0	0.1	49.8	0.1	1	0	0	0	0	0	0	0	0	0	0
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	36	36	0.000146	0	0	0.000158	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000048	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		

Waste Requirements Based on Scenario , SF9

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
float zone	wipes	0.000004	0.000004	100	0	0	1	10	10	0.000040	0	0	0.000044	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	27	27	0.000110	0	0	0.000118	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000481	0.000519
								Totals		47.68284	349.2457	23.84800	134.1192	347.6160	25326.83	420.7765	25808.57

Consumables Based on Scenario SF10 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
high performance liquid chromatograph	acetonitrile	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
										0	0	0	0	0	0	0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
acoustic levitator	air	10	0.01312	0	0	100	1	36	36	0	0	0.47232	0	0	360		
alloy solidification	air	200	0.256	0	0	100	1	12	12	0	0	3.072	0	0	2400		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	5	5	0	0	0.28	0	0	225		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	1	1	0	0	0.00256	0	0	2		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	36	36	0	0	1.10592	0	0	864		
float zone	air	5	0.005973	0	0	100	1	10	10	0	0	0.059733	0	0	50		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	4	4	0	0	0.28806	0	0	224		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		5.280593	4125
acoustic levitator	Ar	41	0.052726	0	0	100	1	36	36	0	0	1.898136	0	0	1476		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	5	5	0	0	0.389375	0	0	225		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	36	36	0	0	1.53792	0	0	864		
float zone	Ar	14	0.02492	0	0	100	1	10	10	0	0	0.2492	0	0	140		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	20	20	0	0	1.2816	0	0	720		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	4	4	0	0	0.1424	0	0	80		
													0	0		5.498631	3505
acoustic levitator	cleaning fluid	1	1	0	100	0	1	36	36	0	36	0	0	36	0		

Facility/ Equipment | Material | Volume per run liters | mass kilogram | % solid | % liq | % gas | equip utiliz-ation | run per facility | runs per mission | solid mass kg | liquid mass kg | gas mass kg | solid volume liter | liquid volume liter | gas volume liter | total mass for material | total volume fo material

Consumables Based on Scenario SF10 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz- ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
alloy solidification	cleaning fluid	1	1	0	100	0	1	12	12	0	12	0	0	12	0		
atmospheric microphysics	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	100	0	1	5	5	0	2.5	0	0	2.5	0		
bulk crystal	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	100	0	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	100	0	1	36	36	0	0.36	0	0	0.36	0		
float zone	cleaning fluid	0.1	0.1	0	100	0	1	10	10	0	1	0	0	1	0		
fluid physics	cleaning fluid	0.1	0.1	0	100	0	1	0	0	0	0	0	0	0	0		
free float	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	100	0	1	27	27	0	0.27	0	0	0.27	0		
premixed gas combustion	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	100	0	1	4	4	0	0.04	0	0	0.04	0		
variable flow shell generator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		52.17	52.17
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
atmospheric microphysics	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	100	0	1	10	10	0	5	0	0	5	0		
fluid physics	deionized water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		
membrane production	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	100	0	1	27	27	0	27	0	0	27	0		
premixed gas combustion	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0.5	0.5	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	100	0	1	1	1	0	140	0	0	140	0		
isoelectric focusing	deion./depyro.	15	15	0	100	0	1	2	2	0	30	0	0	30	0		
protein crystal growth	deion./depyro.	0.7	0.7	0	100	0	1	20	20	0	14	0	0	14	0		
acoustic levitator	distilled water	1	1	0	100	0	1	36	36	0	36	0	0	36	0		
alloy solidification	distilled water	2	2	0	100	0	1	12	12	0	24	0	0	24	0		
autoclave	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	100	0	1	5	5	0	2.5	0	0	2.5	0		
bulk crystal	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		

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Consumables Based on Scenario SF10 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
electrostatic levitator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	100	0	1	36	36	0	3.6	0	0	3.6	0		
free float	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	100	0	1	0	0	0	0	0	0	0	0		
variable flow shell generator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																284.1	284.1
electroepitaxy	GH2	250	0.0225	0	0	100	1	1	1	0	0	0.0225	0	0	250		
													0	0		0.0225	250
acoustic levitator	GHe	2	0.000355	0	0	100	1	36	36	0	0	0.01278	0	0	72		
alloy solidification	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.66626	9336
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	36	36	0.00072	0	0	0.00072	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	5	5	0.0001	0	0	0.0001	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	27	27	0.00054	0	0	0.00054	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.00178	0.00178
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

Consumables Based on Scenario SF10 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz- ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
premixed gas combustion	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	20	20	0	0	9	0	0	7200		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		9.6625	7730
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	20	20	0	0	1.0296	0	0	720		
solid surface burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.0296	720
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0		
													0	0		0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.75	15
critical point phenomena	LHe	150	28.75	0	100	0	1	0	0	0	0	0	0	0	0		
													0	0		0	0
critical point phenomena	LN2	30	24.18	0	100	0	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	100	0	0	0	1	0	0	0	0	0	0		
gas chromatograph - mass spectrometer	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
high performance liquid chromatograph	methenol	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
cutting/polishing system	oil- water solu	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
water deionizer/depyrogenizer	process resin	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
solution crystal	solvents	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
													0	0		0.755	15.01
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	36	36	0.000146	0	0	0.000158	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000048	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	5	5	0.000020	0	0	0.000022	0	0		

Consumables Based on Scenario SF10 Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
float zone	wipes	0.000004	0.000004	100	0	0	1	10	10	0.000040	0	0	0.00004	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	27	27	0.000110	0	0	0.000118	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000485	0.000519
								Totals		1.507265	336.27	23.16008	30.01229	336.27	25666	360.9373	26032.28

Samples Based on Scenario SF10

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
solid surface burning	fuel - solid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	burn catalytic	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel, liquid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	fuel - gaseous	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0		
isoelectric focusing	raw material	0.1	0.15	0	100	0	1	2	2	0	0.3	0	0	0.2	0		
organic & polymer crystal growth	buffer solution	34.4025	34.4025	0	100	0	1	27	27	0	928.8675	0	0	928.8675	0		
bioreactor/incubator	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	staining soluti	0.01	0.01	0	100	0	1	2	2	0	0.02	0	0	0.02	0		
continuous flow electrophoresis	raw material	0.3	0.4	0	100	0	1	1	1	0	0.4	0	0	0.3	0		
contact angle measurement unit	test fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	TGS solution	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	seed crystals	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
fluid physics	TGS solution	2	3.36	0	100	0	1	1	1	0	3.36	0	0	2	0		
protein crystal growth	reservior solut	0.00675	0.0135	0	100	0	1	20	20	0	0.27	0	0	0.135	0		
etching equipment	etchant solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
atmospheric microphysics	acid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	monomer/polymer	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
latex reactor	AMBN process in	0.25	0.2275	0	100	0	1	2	2	0	0.455	0	0	0.5	0		
latex reactor	styrene	0.75	0.6825	0	100	0	1	2	2	0	1.365	0	0	1.5	0		
continuous flow electrophoresis	staining soluti	0.01	0.01	0	100	0	1	1	1	0	0.01	0	0	0.01	0		
continuous flow electrophoresis	buffer solution	2.7	3.5	0	100	0	1	1	1	0	3.5	0	0	2.7	0		
isoelectric focusing	acid	0.3	0.375	0	100	0	1	2	2	0	0.75	0	0	0.6	0		
solution crystal	crystal solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	seed crystal	0.002	0.00164	0	100	0	1	1	1	0	0.00164	0	0	0.002	0		
rotating spherical convection	dielectric stud	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	protein solutio	0.02	0.02	0	100	0	1	20	20	0	0.4	0	0	0.4	0		
bulk crystal	liquid phase en	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	100	0	1	1	1	0	0.25	0	0	0.25	0		
bioreactor/incubator	raw material	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	disinfectant /	0.25	0.25	0	100	0	1	2	2	0	0.5	0	0	0.5	0		
isoelectric focusing	calibration sol	0.3	0.3	0	100	0	1	2	2	0	0.6	0	0	0.6	0		
protein crystal growth	disinfectants	0.001	0.001	0	100	0	1	20	20	0	0.02	0	0	0.02	0		
isoelectric focusing	amphoylte conce	0.15	0.3	0	100	0	1	2	2	0	0.6	0	0	0.3	0		
latex reactor	latex solutions	1	0.91	0	100	0	1	2	2	0	1.82	0	0	2	0		
membrane production	catalyst soluti	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	basic solution	0.3	0.435	0	100	0	1	2	2	0	0.87	0	0	0.6	0		
high performance liquid chromatograph	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																949.3591	946.5045
autoignition furnace	fuel sample - s	0	0	33.3	33.3	33.3	0	0	0	0	0	0	0	0	0		
																0	0
electroepitaxy	III-V group sou	2	11	50	50	0	1	1	1	5.5	5.5	0	1	1	0		
																11	2
free float	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	microcarrier be	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
float zone	raw material	0.1288	0.966	100	0	0	1	10	10	9.66	0	0	1.288	0	0		
organic & polymer crystal growth	acetonitrile	33.36	36.696	100	0	0	1	27	27	990.792	0	0	900.72	0	0		
acoustic levitator	raw material	0.1	0.6	100	0	0	1	36	36	21.6	0	0	3.6	0	0		
organic & polymer crystal growth	polydiacetylene	0.1288	0.2576	100	0	0	1	27	27	6.9552	0	0	3.4776	0	0		

Samples Based on Scenario SF10

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
EM levitator	raw material	0.00177	0.033	100	0	0	1	36	36	1.188	0	0	0.06372	0	0		
optical fiber pulling	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
alloy solidification	raw material	0.66	4.93284	100	0	0	1	12	12	59.19408	0	0	7.92	0	0		
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0		
electrostatic levitator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	20	20	0.1	0	0	0.04	0	0		
cleaning equipment	solid waste	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, large	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bulk crystal	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	semiconductor o	0.2	1.8	100	0	0	1	4	4	7.2	0	0	0.8	0	0		
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	20	20	0.005	0	0	0.007	0	0		
protein crystal growth	growth syringes	5	2	100	0	0	1	20	20	40	0	0	100	0	0		
water deionizer/depyrogenizer	filter cartridg	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	naphthalene	1.0425	1.0425	100	0	0	1	27	27	28.1475	0	0	28.1475	0	0		
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	sample material	0.315	2.523	100	0	0	1	5	5	12.615	0	0	1.575	0	0		
cutting/polishing system	encapsulant mat	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1183.456	1051.638
								Totals		1188.956	954.8591	0	1052.638	947.5045	0	2143.815	2000.143

Waste Requirements Based on Scenario SF10

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili- zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
high performance liquid chromatograph	acetonitrile	0	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
atmospheric microphysics	acid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
isoelectric focusing	acid	0.3	0.375	0	99	1	1	2	2	0	0.7425	0.0075	0	0.594	0.006	0.75	0.6
acoustic levitator	air	10	0.01312	0	0	100	1	36	36	0	0	0.47232	0	0	360		
alloy solidification	air	200	0.256	0	0	100	1	12	12	0	0	3.072	0	0	2400		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	5	5	0	0	0.28	0	0	225		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	1	1	0	0	0.00256	0	0	2		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	36	36	0	0	1.10592	0	0	864		
float zone	air	5	0.005973	0	0	100	1	10	10	0	0	0.059733	0	0	50		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	4	4	0	0	0.28806	0	0	224		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0	5.280593	4125
isoelectric focusing	amphoylte conce	0.15	0.3	0	99	1	1	2	2	0	0.594	0.006	0	0.297	0.003	0.6	0.3
bridgman, large	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	ampoule fragmen	0.001	0.0001	100	0	0	1	5	6	0.0006	0	0	0.006	0	0		
bulk crystal	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.0006	0.006
acoustic levitator	Ar	41	0.052726	0	0	100	1	36	36	0	0	1.898136	0	0	1476		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	5	5	0	0	0.389375	0	0	225		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	36	36	0	0	1.53792	0	0	864		
float zone	Ar	14	0.02492	0	0	100	1	10	10	0	0	0.2492	0	0	140		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	20	20	0	0	1.2816	0	0	720		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	4	4	0	0	0.1424	0	0	80	5.498631	3505
isoelectric focusing	basic solution	0.3	0.435	0	99	1	1	2	2	0	0.8613	0.0087	0	0.594	0.006		

Waste Requirements Based on Scenario SF10

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
																0.87	0.6
UV sterilization unit	biological wast	0	0	89.98	10	0.01	0	0	0	0	0	0	0	0	0		
																0	0
cutting/polishing system	boule fragments	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	buffer solution	2.7	3.5	2	97.9	0.1	1	1	1	0.07	3.4265	0.0035	0.054	2.6433	0.0027		
																3.5	2.7
isoelectric focusing	calibration sol	0.3	0.3	0	99.9	0.1	1	2	2	0	0.5994	0.0006	0	0.5994	0.0006		
																0.6	0.6
membrane production	catalyst soluti	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																0	0
acoustic levitator	cleaning fluid	1	1	0	99	1	1	36	36	0	35.64	0.36	0	35.64	0.36		
alloy solidification	cleaning fluid	1	1	0	99	1	1	12	12	0	11.88	0.12	0	11.88	0.12		
atmospheric microphysics	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	99	1	1	5	5	0	2.475	0.025	0	2.475	0.025		
bulk crystal	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	99	1	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	99	1	1	36	36	0	0.3564	0.0036	0	0.3564	0.0036		
float zone	cleaning fluid	0.1	0.1	0	99	1	1	10	10	0	0.99	0.01	0	0.99	0.01		
fluid physics	cleaning fluid	0.1	0.1	0	99	1	1	1	1	0	0.099	0.001	0	0.099	0.001		
free float	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	99	1	1	27	27	0	0.2673	0.0027	0	0.2673	0.0027		
premixed gas combustion	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	99	1	1	4	4	0	0.0396	0.0004	0	0.0396	0.0004		
variable flow shell generator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																52.27	52.27
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
autoignition furnace	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
droplet/spray burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
premixed gas combustion	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
solid surface burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
																0	0
critical point phenomena	cryogen	0	0	0	0	64560	1	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0		
																5	5
atmospheric microphysics	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		

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Waste Requirements Based on Scenario SF10

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
autoignition furnace	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	99.9	0.1	1	10	10	0	4.995	0.005	0	4.995	0.005		
fluid physics	deionized water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
membrane production	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	99.9	0.1	1	27	27	0	26.973	0.027	0	26.973	0.027		
premixed gas combustion	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0	0	0	99.9	0.1	1	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	99.9	0.1	1	1	1	0	139.86	0.14	0	139.86	0.14		
isoelectric focusing	deion./depyro.	15	15	0	99.9	0.1	1	2	2	0	29.97	0.03	0	29.97	0.03		
protein crystal growth	deion./depyro.	0.7	0.7	0	99.9	0.1	1	20	20	0	13.986	0.014	0	13.986	0.014		
acoustic levitator	distilled water	1	1	0	99.9	0.1	1	36	36	0	35.964	0.036	0	35.964	0.036		
alloy solidification	distilled water	2	2	0	99.9	0.1	1	12	12	0	23.976	0.024	0	23.976	0.024		
autoclave	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	99.9	0.1	1	5	5	0	2.4975	0.0025	0	2.4975	0.0025		
bulk crystal	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
electrostatic levitator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	99.9	0.1	1	36	36	0	3.5964	0.0036	0	3.5964	0.0036		
free float	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	99.9	0.1	1	4	4	0	1.998	0.002	0	1.998	0.002		
variable flow shell generator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																286.1	286.1
rotating spherical convection	dielectric stud	0	0	0	99.99	0.01	0	0	0	0	0	0	0	0	0		
																0	0
isoelectric focusing	disinfectant /	0.25	0.25	0	99	1	1	2	2	0	0.495	0.005	0	0.495	0.005		
bioreactor/incubator	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	99	1	1	1	1	0	0.2475	0.0025	0	0.2475	0.0025		
high performance liquid chromatograph	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
protein crystal growth	disinfectants	0.001	0.001	0	99	1	1	20	20	0	0.0198	0.0002	0	0.0198	0.0002		
																0.77	0.77
solid surface burning	fuel	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
premixed gas	fuel	0	0	0	0	10	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0		
autoignition furnace	fuel	0	0	0.333	0.333	0.333	0	0	0	0	0	0	0	0	0		
																0	0
alloy solidificaton	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
acoustic levitator	GHe	2	0.000355	0	0	100	1	36	36	0	0	0.01278	0	0	72		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

Waste Requirements Based on Scenario 5F10

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0	1.66626	9336
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	36	36	0.00072	0	0	0.00072	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	5	5	0.0001	0	0	0.0001	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	27	27	0.00054	0	0	0.00054	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.00178	0.00178
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	20	20	0	0	9	0	0	7200		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0	9.6625	7730
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	20	20	0	0	1.0296	0	0	720	1.0296	720
protein crystal growth	growth syringes	5	2	100	0	0	1	20	20	40	0	0	100	0	0	40	100
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	20	20	0.005	0	0	0.007	0	0	0.005	0.007
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0	0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.75	15
critical point phenomena	LHe	150	15.489	0	0	69940	1	0	0	0	0	0	0	0	0	0	0
critical point phenomena	LN2	30	24.18	0	0	64560	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	0	64560	0	0	1	0	0	0	0	0	0		

Waste Requirements Based on Scenario SF10

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
gas chromatograph - mass spectrometer	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0	0	0
high performance liquid chromatograph	methonol	0	0	0	90	10	0	0	0	0	0	0	0	0	0	0	0
bioreactor/incubator	microcarrier be	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
cutting/polishing system	oil- water solu	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
water deionizer/depyrogenizer	process resin	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
protein crystal growth	protein solutio	0.02	0.02	0	99	1	1	20	20	0	0.396	0.004	0	0.396	0.004	0.4	0.4
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	20	20	0.1	0	0	0.04	0	0	0.1	0.04
cutting/polishing system	raw material	0	0	99	0	1	0	0	0	0	0	0	0	0	0	0	0
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0	6	4
protein crystal growth	reservior solut	0.00675	0.0135	0	99	1	1	20	20	0	0.2673	0.0027	0	0.13365	0.00135	0.27	0.135
general purpose hand tools	residual gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
cleaning equipment	solid waste	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0	0	0
solution crystal	solvents	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	staining soluti	0.01	0.01	0	99	1	1	1	1	0	0.0099	0.0001	0	0.0099	0.0001		
isoelectric focusing	staining soluti	0.01	0.01	0	99	1	1	2	2	0	0.0198	0.0002	0	0.0198	0.0002	0.03	0.03
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.755	15.01
solution crystal	TGS solution	0	0	0.1	49.8	0.1	1	0	0	0	0	0	0	0	0	0	0
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	36	36	0.000146	0	0	0.000158	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000048	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	5	5	0.000020	0	0	0.000022	0	0		
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		

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Waste Requirements Based on Scenario SF10

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
float zone	wipes	0.000004	0.000004	100	0	0	1	10	10	0.000040	0	0	0.000044	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	27	27	0.000110	0	0	0.000118	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000485	0.000523
								Totals		47.68286	350.2402	23.98738	134.1193	348.6105	25416.84	421.9104	25899.57

Consumables Based on Global Mission

Consumables Based on Global Mission

Facility/ Equipment | Material | Volume per run liters | mass kilogram | % solid | % liq | % gas | equip utiliz-ation | run per facility | runs per mission | solid mass kg | liquid mass kg | gas mass kg | solid volume liter | liquid volume liter | gas volume liter | total mass for material | total volume fo material

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
high performance liquid chromatograph	acetonitrile	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
										0	0	0	0	0	0	0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
acoustic levitator	air	10	0.01312	0	0	100	1	36	36	0	0	0.47232	0	0	360		
alloy solidification	air	200	0.256	0	0	100	1	12	12	0	0	3.072	0	0	2400		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	10	10	0	0	0.56	0	0	450		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	1	1	0	0	0.00256	0	0	2		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	36	36	0	0	1.10592	0	0	864		
float zone	air	5	0.005973	0	0	100	1	10	10	0	0	0.059733	0	0	50		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	4	4	0	0	0.28806	0	0	224		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		5.560593	4350
acoustic levitator	Ar	41	0.052726	0	0	100	1	36	36	0	0	1.898136	0	0	1476		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	10	10	0	0	0.77875	0	0	450		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	36	36	0	0	1.53792	0	0	864		
float zone	Ar	14	0.02492	0	0	100	1	10	10	0	0	0.2492	0	0	140		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	20	20	0	0	1.2816	0	0	720		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	4	4	0	0	0.1424	0	0	80		
													0	0		5.888006	3730
acoustic levitator	cleaning fluid	1	1	0	100	0	1	36	36	0	36	0	0	36	0		

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Consumables Based on Global Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
alloy solidification	cleaning fluid	1	1	0	100	0	1	12	12	0	12	0	0	12	0		
atmospheric microphysics	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	100	0	1	10	10	0	5	0	0	5	0		
bulk crystal	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	100	0	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	100	0	1	36	36	0	0.36	0	0	0.36	0		
float zone	cleaning fluid	0.1	0.1	0	100	0	1	10	10	0	1	0	0	1	0		
fluid physics	cleaning fluid	0.1	0.1	0	100	0	1	1	1	0	0.1	0	0	0.1	0		
free float	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	100	0	1	27	27	0	0.27	0	0	0.27	0		
premixed gas combustion	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	100	0	1	4	4	0	0.04	0	0	0.04	0		
variable flow shell generator	cleaning fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		54.77	54.77
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
atmospheric microphysics	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
autoignition furnace	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	100	0	1	10	10	0	5	0	0	5	0		
fluid physics	deionized water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		
membrane production	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	100	0	1	27	27	0	27	0	0	27	0		
premixed gas combustion	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0.5	0.5	0	100	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	100	0	1	1	1	0	140	0	0	140	0		
isoelectric focusing	deion./depyro.	15	15	0	100	0	1	2	2	0	30	0	0	30	0		
protein crystal growth	deion./depyro.	0.7	0.7	0	100	0	1	20	20	0	14	0	0	14	0		
acoustic levitator	distilled water	1	1	0	100	0	1	36	36	0	36	0	0	36	0		
alloy solidification	distilled water	2	2	0	100	0	1	12	12	0	24	0	0	24	0		
autoclave	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	100	0	1	10	10	0	5	0	0	5	0		
bulk crystal	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	100	0	1	1	1	0	1	0	0	1	0		

Consumables Based on Global Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
electrostatic levitator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	100	0	1	36	36	0	3.6	0	0	3.6	0		
free float	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	100	0	1	4	4	0	2	0	0	2	0		
variable flow shell generator	distilled water	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
																288.6	288.6
electroepitaxy	GN2	250	0.0225	0	0	100	1	1	1	0	0	0.0225	0	0	250		
													0	0		0.0225	250
acoustic levitator	GHe	2	0.000355	0	0	100	1	36	36	0	0	0.01278	0	0	72		
alloy solidification	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.66626	9336
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	36	36	0.00072	0	0	0.00072	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	10	10	0.0002	0	0	0.0002	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	27	27	0.00054	0	0	0.00054	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.00188	0.00188
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
droplet/spray burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

Consumables Based on Global Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utiliz-ation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
premixed gas combustion	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	20	20	0	0	9	0	0	7200		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		9.6625	7730
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	20	20	0	0	1.0296	0	0	720		
solid surface burning	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		1.0296	720
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0		
													0	0		0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0.75	15
critical point phenomena	LHe	150	28.75	0	100	0	1	0	0	0	0	0	0	0	0		
													0	0		0	0
critical point phenomena	LN2	30	24.18	0	100	0	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	100	0	0	0	1	0	0	0	0	0	0		
gas chromatograph - mass spectrometer	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
high performance liquid chromatograph	methenol	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
cutting/polishing system	oil- water solu	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
water deionizer/depyrogenizer	process resin	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
													0	0		0	0
solution crystal	solvents	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
													0	0		0	0
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
													0	0		0.755	15.01
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	36	36	0.000146	0	0	0.000158	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000048	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	10	10	0.000040	0	0	0.000044	0	0		

Consumables Based on Global Mission

Facility/ Equipment	Material	Volume per run liters	mass kilogram	% solid	% liq	% gas	equip utilization	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liquid volume liter	gas volume liter	total mass for material	total volume fo material
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
float zone	wipes	0.000004	0.000004	100	0	0	1	10	10	0.000040	0	0	0.00004	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	27	27	0.000110	0	0	0.000118	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000505	0.000541
									Totals	1.507385	343.37	23.82945	30.01242	343.37	26116	368.7068	26489.38

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Samples Based on Global Mission

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
solid surface burning	fuel - solid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	burn catalytic	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel, liquid	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	fuel - gaseous	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0		
isoelectric focusing	raw material	0.1	0.15	0	100	0	1	2	2	0	0.3	0	0	0.2	0		
organic & polymer crystal growth	buffer solution	34.4025	34.4025	0	100	0	1	27	27	0	928.8675	0	0	928.8675	0		
bioreactor/incubator	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
isoelectric focusing	staining soluti	0.01	0.01	0	100	0	1	2	2	0	0.02	0	0	0.02	0		
continuous flow electrophoresis	raw material	0.3	0.4	0	100	0	1	1	1	0	0.4	0	0	0.3	0		
contact angle measurement unit	test fluid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	TGS solution	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
solution crystal	seed crystals	0	0	0	100	0	0	0	0	0	0	0	0	2	0		
fluid physics	TGS solution	2	3.36	0	100	0	1	1	1	0	3.36	0	0	0.135	0		
protein crystal growth	reservior solut	0.00675	0.0135	0	100	0	1	20	20	0	0.27	0	0	0	0		
etching equipment	etchant solutio	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
atmospheric microphysics	acid	0	0	0	100	0	0	0	0	0	0	0	0	0	0		
membrane production	monomer/polymer	0	0	0	100	0	0	0	0	0	0	0	0	0.5	0		
latex reactor	AMBN process in	0.25	0.2275	0	100	0	1	2	2	0	0.455	0	0	1.5	0		
latex reactor	styrene	0.75	0.6825	0	100	0	1	2	2	0	1.365	0	0	0.01	0		
continuous flow electrophoresis	staining soluti	0.01	0.01	0	100	0	1	1	1	0	0.01	0	0	2.7	0		
continuous flow electrophoresis	buffer solution	2.7	3.5	0	100	0	1	1	1	0	3.5	0	0	0.6	0		
isoelectric focusing	acid	0.3	0.375	0	100	0	1	2	2	0	0.75	0	0	0	0		
solution crystal	crystal solutio	0	0	0	100	0	0	0	0	0	0	0	0	0.002	0		
electroepitaxy	seed crystal	0.002	0.00164	0	100	0	1	1	1	0	0.00164	0	0	0	0		
rotating spherical convection	dielectric stud	0	0	0	100	0	0	0	0	0	0	0	0	0.4	0		
protein crystal growth	protein solutio	0.02	0.02	0	100	0	1	20	20	0	0.4	0	0	0	0		
bulk crystal	liquid phase en	0	0	0	100	0	0	0	0	0	0	0	0	0.25	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	100	0	1	1	1	0	0.25	0	0	0	0		
bioreactor/incubator	raw material	0	0	0	100	0	0	0	0	0	0	0	0	0.5	0		
isoelectric focusing	disinfectant /	0.25	0.25	0	100	0	1	2	2	0	0.5	0	0	0.6	0		
isoelectric focusing	calibration sol	0.3	0.3	0	100	0	1	2	2	0	0.6	0	0	0.02	0		
protein crystal growth	disinfectants	0.001	0.001	0	100	0	1	20	20	0	0.02	0	0	0.3	0		
isoelectric focusing	amphoylte conce	0.15	0.3	0	100	0	1	2	2	0	0.6	0	0	2	0		
latex reactor	latex solutions	1	0.91	0	100	0	1	2	2	0	1.82	0	0	0	0		
membrane production	catalyst soluti	0	0	0	100	0	0	0	0	0	0	0	0	0.6	0		
isoelectric focusing	basic solution	0.3	0.435	0	100	0	1	2	2	0	0.87	0	0	0	0		
high performance liquid chromatograph	disinfectants	0	0	0	100	0	0	0	0	0	0	0	0	0	0	949.3591	946.5045
autoignition furnace	fuel sample - s	0	0	33.3	33.3	33.3	0	0	0	0	0	0	0	0	0	0	0
electroepitaxy	III-V group sou	2	11	50	50	0	1	1	1	5.5	5.5	0	1	1	0	11	2
free float	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	microcarrier be	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
float zone	raw material	0.1288	0.966	100	0	0	1	10	10	9.66	0	0	1.288	0	0		
organic & polymer crystal growth	aretonitrile	33.36	36.696	100	0	0	1	27	27	990.792	0	0	900.72	0	0		
acoustic levitator	raw material	0.1	0.6	100	0	0	1	36	36	21.6	0	0	3.6	0	0		
organic & polymer crystal growth	polydiacetylene	0.1288	0.2576	100	0	0	1	27	27	6.9552	0	0	3.4776	0	0		

Samples Based on Global Mission

Facility/ Equipment	Material	Volume per run liter	Mass per run kilogram	% solid	% liq	%gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid vol. liter	liquid vol. liter	gas vol. liter	total mass for material	total vol. for material
EM levitator	raw material	0.00177	0.033	100	0	0	1	36	36	1.188	0	0	0.06372	0	0		
optical fiber pulling	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
alloy solidification	raw material	0.66	4.93284	100	0	0	1	12	12	59.19408	0	0	7.92	0	0		
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0		
electrostatic levitator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
high temperature furnace	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	20	20	0.1	0	0	0.04	0	0		
cleaning equipment	solid waste	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, large	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bulk crystal	sample material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
variable flow shell generator	raw material	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	semiconductor o	0.2	1.8	100	0	0	1	4	4	7.2	0	0	0.8	0	0		
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	20	20	0.005	0	0	0.007	0	0		
protein crystal growth	growth syringes	5	2	100	0	0	1	20	20	40	0	0	100	0	0		
water deionizer/depyrogenizer	filter cartridg	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	naphthalene	1.0425	1.0425	100	0	0	1	27	27	28.1475	0	0	28.1475	0	0		
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	sample material	0.315	2.523	100	0	0	1	10	10	25.23	0	0	3.15	0	0		
cutting/polishing system	encapsulant mat	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																1196.071	1053.213
								Totals		1201.571	954.8591	0	1054.213	947.5045	0	2156.430	2001.718

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Waste Requirements Based on Global Mission

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili- zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
high performance liquid chromatograph	acetonitrile	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																0	0
gas chromatograph - mass spectrometer	acetylene	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
atmospheric microphysics	acid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
isoelectric focusing	acid	0.3	0.375	0	99	1	1	2	2 .	0	0.7425	0.0075	0	0.594	0.006		
																0.75	0.6
acoustic levitator	air	10	0.01312	0	0	100	1	36	36	0	0	0.47232	0	0	360		
alloy solidification	air	200	0.256	0	0	100	1	12	12	0	0	3.072	0	0	2400		
atmospheric microphysics	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
autoignition furnace	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	air	45	0.056	0	0	100	1	10	10	0	0	0.56	0	0	450		
bulk crystal	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
chemical supply storage facility	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
droplet/spray burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
electroepitaxy	air	2	0.00256	0	0	100	1	1	1	0	0	0.00256	0	0	2		
electrostatic levitator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	air	24	0.03072	0	0	100	1	36	36	0	0	1.10592	0	0	864		
float zone	air	5	0.005973	0	0	100	1	10	10	0	0	0.059733	0	0	50		
free float	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
premixed gas combustion	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solid surface burning	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV sterilization unit	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	air	56	0.072015	0	0	100	1	4	4	0	0	0.28806	0	0	224		
variable flow shell generator	air	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																5.560593	4350
isoelectric focusing	amphoylte conce	0.15	0.3	0	99	1	1	2	2	0	0.594	0.006	0	0.297	0.003		
																0.6	0.3
bridgman, large	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
bridgman, small	ampoule fragmen	0.001	0.0001	100	0	0	1	10	6	0.0006	0	0	0.006	0	0		
bulk crystal	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
cutting/polishing system	ampoule fragmen	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.0006	0.006
acoustic levitator	Ar	41	0.052726	0	0	100	1	36	36	0	0	1.898136	0	0	1476		
atmospheric microphysics	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, large	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bridgman, small	Ar	45	0.077875	0	0	100	1	10	10	0	0	0.77875	0	0	450		
bulk crystal	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
EM levitator	Ar	24	0.04272	0	0	100	1	36	36	0	0	1.53792	0	0	864		
float zone	Ar	14	0.02492	0	0	100	1	10	10	0	0	0.2492	0	0	140		
gas chromatograph - mass spectrometer	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
optical fiber pulling	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	Ar	36	0.06408	0	0	100	1	20	20	0	0	1.2816	0	0	720		
scanning electron microscope	Ar	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	Ar	20	0.0356	0	0	100	1	4	4	0	0	0.1424	0	0	80		
																5.888006	3730
isoelectric focusing	basic solution	0.3	0.435	0	99	1	1	2	2	0	0.8613	0.0087	0	0.594	0.006		

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Waste Requirements Based on Global Mission

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
																0.87	0.6
UV sterilization unit	biological wast	0	0	89.98	10	0.01	0	0	0	0	0	0	0	0	0		
																0	0
cutting/polishing system	boule fragments	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	buffer solution	2.7	3.5	2	97.9	0.1	1	1	1	0.07	3.4265	0.0035	0.054	2.6433	0.0027		
																3.5	2.7
isoelectric focusing	calibration sol	0.3	0.3	0	99.9	0.1	1	2	2	0	0.5994	0.0006	0	0.5994	0.0006		
																0.6	0.6
membrane production	catalyst soluti	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																0	0
acoustic levitator	cleaning fluid	1	1	0	99	1	1	36	36	0	35.64	0.36	0	35.64	0.36		
alloy solidification	cleaning fluid	1	1	0	99	1	1	12	12	0	11.88	0.12	0	11.88	0.12		
atmospheric microphysics	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
autoignition furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, large	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
bridgman, small	cleaning fluid	0.5	0.5	0	99	1	1	10	10	0	4.95	0.05	0	4.95	0.05		
bulk crystal	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
cleaning equipment	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
critical point phenomena	cleaning fluid	1	1	0	99	1	1	0	0	0	0	0	0	0	0		
droplet/spray burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
electrostatic levitator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
EM levitator	cleaning fluid	0.01	0.01	0	99	1	1	36	36	0	0.3564	0.0036	0	0.3564	0.0036		
float zone	cleaning fluid	0.1	0.1	0	99	1	1	10	10	0	0.99	0.01	0	0.99	0.01		
fluid physics	cleaning fluid	0.1	0.1	0	99	1	1	1	1	0	0.099	0.001	0	0.099	0.001		
free float	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
high temperature furnace	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
membrane production	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	cleaning fluid	0.01	0.01	0	99	1	1	27	27	0	0.2673	0.0027	0	0.2673	0.0027		
premixed gas combustion	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
rotating spherical convection	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
solid surface burning	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	cleaning fluid	0.01	0.01	0	99	1	1	4	4	0	0.0396	0.0004	0	0.0396	0.0004		
variable flow shell generator	cleaning fluid	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
																54.77	54.77
atmospheric microphysics	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bioreactor/incubator	CO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																0	0
autoignition furnace	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
droplet/spray burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
premixed gas combustion	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
solid surface burning	combustion prod	0	0	4	1	95	0	0	0	0	0	0	0	0	0		
																0	0
critical point phenomena	cryogen	0	0	0	0	64560	1	0	0	0	0	0	0	0	0		
																0	0
continuous flow electrophoresis	culture medium	5	5	0	100	0	1	1	1	0	5	0	0	5	0		
																5	5
atmospheric microphysics	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		

Waste Requirements Based on Global Mission

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
autoignition furnace	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
droplet/spray burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
float zone	deionized water	0.5	0.5	0	99.9	0.1	1	10	10	0	4.995	0.005	0	4.995	0.005		
fluid physics	deionized water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
membrane production	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	deionized water	1	1	0	99.9	0.1	1	27	27	0	26.973	0.027	0	26.973	0.027		
premixed gas combustion	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solid surface burning	deionized water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
solution crystal	deionized water	0	0	0	99.9	0.1	1	0	0	0	0	0	0	0	0		
bioreactor/incubator	deion./depyro.	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	deion./depyro.	140	140	0	99.9	0.1	1	1	1	0	139.86	0.14	0	139.86	0.14		
isoelectric focusing	deion./depyro.	15	15	0	99.9	0.1	1	2	2	0	29.97	0.03	0	29.97	0.03		
protein crystal growth	deion./depyro.	0.7	0.7	0	99.9	0.1	1	20	20	0	13.986	0.014	0	13.986	0.014		
acoustic levitator	distilled water	1	1	0	99.9	0.1	1	36	36	0	35.964	0.036	0	35.964	0.036		
alloy solidification	distilled water	2	2	0	99.9	0.1	1	12	12	0	23.976	0.024	0	23.976	0.024		
autoclave	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, large	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
bridgman, small	distilled water	0.5	0.5	0	99.9	0.1	1	10	10	0	4.995	0.005	0	4.995	0.005		
bulk crystal	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
cutting/polishing system	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
electroepitaxy	distilled water	1	1	0	99.9	0.1	1	1	1	0	0.999	0.001	0	0.999	0.001		
electrostatic levitator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
EM levitator	distilled water	0.1	0.1	0	99.9	0.1	1	36	36	0	3.5964	0.0036	0	3.5964	0.0036		
free float	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high performance liquid chromatograph	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
high temperature furnace	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
optical fiber pulling	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	distilled water	0.5	0.5	0	99.9	0.1	1	4	4	0	1.998	0.002	0	1.998	0.002		
variable flow shell generator	distilled water	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0		
																288.6	288.6
rotating spherical convection	dielectric stud	0	0	0	99.99	0.01	0	0	0	0	0	0	0	0	0		
																0	0
isoelectric focusing	disinfectant /	0.25	0.25	0	99	1	1	2	2	0	0.495	0.005	0	0.495	0.005		
bioreactor/incubator	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
continuous flow electrophoresis	disinfectants	0.25	0.25	0	99	1	1	1	1	0	0.2475	0.0025	0	0.2475	0.0025		
high performance liquid chromatograph	disinfectants	0	0	0	99	1	0	0	0	0	0	0	0	0	0		
protein crystal growth	disinfectants	0.001	0.001	0	99	1	1	20	20	0	0.0198	0.0002	0	0.0198	0.0002		
																0.77	0.77
solid surface burning	fuel	0	0	1	0	0	0	0	0	0	0	0	0	0	0		
premixed gas	fuel	0	0	0	0	10	0	0	0	0	0	0	0	0	0		
droplet/spray burning	fuel	0	0	0	1	0.1	0	0	0	0	0	0	0	0	0		
autoignition furnace	fuel	0	0	0.333	0.333	0.333	0	0	0	0	0	0	0	0	0		
																0	0
alloy solidificaton	GHe	700	0.12495	0	0	100	1	12	12	0	0	1.4994	0	0	8400		
acoustic levitator	GHe	2	0.000355	0	0	100	1	36	36	0	0	0.01278	0	0	72		
atmospheric microphysics	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GHe	200	0.0357	0	0	100	1	0	0	0	0	0	0	0	0		
EM levitator	GHe	24	0.00428	0	0	100	1	36	36	0	0	0.15408	0	0	864		
gas chromatograph - mass spectrometer	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		

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Waste Requirements Based on Global Mission

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
variable flow shell generator	GHe	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																1.66626	9336
acoustic levitator	gloves	0.00002	0.00002	100	0	0	1	36	36	0.00072	0	0	0.00072	0	0		
alloy solidification	gloves	0.00002	0.00002	100	0	0	1	12	12	0.00024	0	0	0.00024	0	0		
bridgman, small	gloves	0.00002	0.00002	100	0	0	1	10	10	0.0002	0	0	0.0002	0	0		
continuous flow electrophoresis	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
electroepitaxy	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
fluid physics	gloves	0.00002	0.00002	100	0	0	1	1	1	0.00002	0	0	0.00002	0	0		
latex reactor	gloves	0.00002	0.00002	100	0	0	1	2	2	0.00004	0	0	0.00004	0	0		
optical fiber pulling	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	gloves	0.00002	0.00002	100	0	0	1	27	27	0.00054	0	0	0.00054	0	0		
rotating spherical convection	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	gloves	0.00002	0.00002	100	0	0	1	4	4	0.00008	0	0	0.00008	0	0		
variable flow shell generator	gloves	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.00188	0.00188
atmospheric microphysics	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
bulk crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
camera locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
critical point phenomena	GN2	200	0.25	0	0	100	1	0	0	0	0	0	0	0	0		
electroepitaxy	GN2	500	0.625	0	0	100	1	1	1	0	0	0.625	0	0	500		
film locker	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
fluid physics	GN2	30	0.0375	0	0	100	1	1	1	0	0	0.0375	0	0	30		
gas chromatograph - mass spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
gas mixing & distribution system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
glovebox, materials processing	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GN2	360	0.45	0	0	100	1	20	20	0	0	9	0	0	7200		
rotating spherical convection	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
solution crystal	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
UV/VIS/NIR spectrometer	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
x-ray system	GN2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
																9.6625	7730
atmospheric microphysics	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
high temperature furnace	GO2	0	0	0	0	100	0	0	0	0	0	0	0	0	0		
protein crystal growth	GO2	36	0.05148	0	0	100	1	20	20	0	0	1.0296	0	0	720		
																1.0296	720
protein crystal growth	growth syringes	5	2	100	0	0	1	20	20	40	0	0	100	0	0		
																40	100
protein crystal growth	high vacuum wax	0.00035	0.00025	100	0	0	1	20	20	0.005	0	0	0.007	0	0		
																0.005	0.007
alloy solidification	inert gas	0	0	0	0	100	1	12	12	0	0	0	0	0	0		
																0	0
electroepitaxy	lab clothing	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
fluid physics	lab clothing	0	0	100	0	0	1	1	1	0	0	0	0	0	0		
solution crystal	lab clothing	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.75	15
critical point phenomena	LHe	150	15.489	0	0	69940	1	0	0	0	0	0	0	0	0		
																0	0
critical point phenomena	LN2	30	24.18	0	0	64560	1	0	0	0	0	0	0	0	0		
freezer	LN2	0	0	0	0	64560	0	0	1	0	0	0	0	0	0		

Waste Requirements Based on Global Mission

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
gas chromatograph - mass spectrometer	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
scanning electron microscope	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0		
variable flow shell generator	LN2	0	0	0	0	64560	0	0	0	0	0	0	0	0	0	0	0
high performance liquid chromatograph	methonol	0	0	0	90	10	0	0	0	0	0	0	0	0	0	0	0
bioreactor/incubator	microcarrier be	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
cutting/polishing system	oil- water solu	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
variable flow shell generator	oxidizing atmos	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
water deionizer/depyrogenizer	process resin	0	0	99	1	0	0	0	0	0	0	0	0	0	0	0	0
protein crystal growth	protein solutio	0.02	0.02	0	99	1	1	20	20	0	0.396	0.004	0	0.396	0.004	0.4	0.4
protein crystal growth	Quartz tubes	0.002	0.005	100	0	0	1	20	20	0.1	0	0	0.04	0	0	0.1	0.04
cutting/polishing system	raw material	0	0	99	0	1	0	0	0	0	0	0	0	0	0	0	0
latex reactor	reactors	2	3	100	0	0	1	2	2	6	0	0	4	0	0	6	4
protein crystal growth	reservior solut	0.00675	0.0135	0	99	1	1	20	20	0	0.2673	0.0027	0	0.13365	0.00135	0.27	0.135
general purpose hand tools	residual gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
atmospheric microphysics	seed production	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0
electrostatic levitator	selected gases	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0
cleaning equipment	solid waste	0	0	99.99	0	0.01	0	0	0	0	0	0	0	0	0	0	0
solution crystal	solvents	0	0	0	99.9	0.1	0	0	0	0	0	0	0	0	0	0	0
continuous flow electrophoresis	staining soluti	0.01	0.01	0	99	1	1	1	1	0	0.0099	0.0001	0	0.0099	0.0001		
isoelectric focusing	staining soluti	0.01	0.01	0	99	1	1	2	2	0	0.0198	0.0002	0	0.0198	0.0002	0.03	0.03
continuous flow electrophoresis	test tubes	0.01	0.005	100	0	0	1	1	1	0.005	0	0	0.01	0	0		
electroepitaxy	test tubes	15	0.75	100	0	0	1	1	1	0.75	0	0	15	0	0		
solution crystal	test tubes	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0.755	15.01
solution crystal	TGS solution	0	0	0.1	49.8	0.1	1	0	0	0	0	0	0	0	0	0	0
acoustic levitator	wipes	0.000004	0.000004	100	0	0	1	36	36	0.000146	0	0	0.000158	0	0		
alloy solidification	wipes	0.000004	0.000004	100	0	0	1	12	12	0.000048	0	0	0.000052	0	0		
autoignition furnace	wipes	0	0	100	0	0	1	0	0	0	0	0	0	0	0		
bridgman, small	wipes	0.000004	0.000004	100	0	0	1	10	10	0.000040	0	0	0.000044	0	0		
continuous flow electrophoresis	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
critical point phenomena	wipes	0.000004	0.000004	100	0	0	1	0	0	0	0	0	0	0	0		
electroepitaxy	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		

Waste Requirements Based on Global Mission

Facility/ Equipment	Material	Volume per run liter	Mass per run kg	% solid	% liq.	% gas	equip. utili-zation	run per facility	runs per mission	solid mass kg	liquid mass kg	gas mass kg	solid volume liter	liq. volume liter	gas volume liter	total mass material	total volume material
float zone	wipes	0.000004	0.000004	100	0	0	1	10	10	0.000040	0	0	0.000044	0	0		
fluid physics	wipes	0.000004	0.000004	100	0	0	1	1	1	0.000004	0	0	0.000004	0	0		
latex reactor	wipes	0.000004	0.000004	100	0	0	1	2	2	0.000008	0	0	0.000008	0	0		
membrane production	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
optical fiber pulling	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
organic & polymer crystal growth	wipes	0.000004	0.000004	100	0	0	1	27	27	0.000110	0	0	0.000118	0	0		
protein crystal growth	wipes	0.000004	0.000004	100	0	0	1	20	20	0.000081	0	0	0.000088	0	0		
rotating spherical convection	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
solution crystal	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
vapor crystal growth facility	wipes	0.000004	0.000004	100	0	0	1	4	4	0.000016	0	0	0.000017	0	0		
variable flow shell generator	wipes	0	0	100	0	0	0	0	0	0	0	0	0	0	0		
																0.000505	0.000545
								Totals		47.68298	355.2127	24.68425	134.1194	353.5830	25866.86	427.5799	26354.57

MATERIALS REQUIRED BASED ON

SCENARIO NUMBER 1

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Ad. Automated Directional	Air	G	175.000	0.22400	1.00000	175.000	0.22400
Ad. Automated Directional	Argon	G	175.000	0.31150	1.00000	175.000	0.31150
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	6.00000	498.000	0.04500
High Temperature Acoustic	GN2	G	90.0000	0.11570	0.00000	0.00000	0.00000
Multiple Experiment Processing	Air	G	175.000	0.22400	9.00000	1575.00	2.01600
Multiple Experiment Processing	Argon	G	175.000	0.31150	9.00000	1575.00	2.80350
Multiple Experiment Processing	Helium	G	4.00000	0.00071	9.00000	36.0000	0.00639
Normal Freezing Furnace-1	Air	G	175.000	0.22400	1.00000	175.000	0.22400
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	1.00000	175.000	0.31150
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	2.00000	3.36000	0.00598
			Totals:			4387.36	5.94787
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	1.00000	0.50000	0.50000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	1.00000	2.00000	2.00000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	1.00000	0.12880	0.25760
Fluid Experiment System.	Model Fluids	L	1.00000	1.00000	1.00000	1.00000	1.00000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	1.00000	4.00000	4.00000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	9.00000	4.50000	4.50000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	9.00000	18.0000	18.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	1.00000	0.50000	0.50000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	1.00000	2.00000	2.00000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	20.0000	2.00000	2.00000
			Totals:			34.6288	34.7576
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	2.00000	0.04000	0.20000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	6.00000	0.07800	0.60000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	9.00000	1.17000	6.30000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	1.00000	0.45700	0.43500
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	2.00000	2.08500	2.08500
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	1.00000	0.02000	0.10000
			Totals:			4.08640	11.6124
					Grand Total	4426.07	52.3179

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MATERIALS REQUIRED BASED ON
SCENARIO NUMBER 2

Material Requirements

Facility	Material	S:Solid L:Liquid G:Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Ad. Automated Directional	Air	G	175.000	0.22400	1.00000	175.000	0.22400
Ad. Automated Directional	Argon	G	175.000	0.31150	1.00000	175.000	0.31150
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	6.00000	498.000	0.04500
High Temperature Acoustic	GN2	G	90.0000	0.11570	0.00000	0.00000	0.00000
Multiple Experiment Processing	Air	G	175.000	0.22400	15.0000	2625.00	3.36000
Multiple Experiment Processing	Argon	G	175.000	0.31150	15.0000	2625.00	4.67250
Multiple Experiment Processing	Helium	G	4.00000	0.00071	15.0000	60.0000	0.01065
Normal Freezing Furnace-1	Air	G	175.000	0.22400	1.00000	175.000	0.22400
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	1.00000	175.000	0.31150
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	2.00000	3.36000	0.00598
			Totals:			6511.36	9.16513
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	1.00000	0.50000	0.50000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	1.00000	2.00000	2.00000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	1.00000	0.12880	0.25760
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	1.00000	1.00000	1.00000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	1.00000	4.00000	4.00000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	15.0000	7.50000	7.50000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	15.0000	30.0000	30.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	1.00000	0.50000	0.50000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	1.00000	2.00000	2.00000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	32.0000	3.20000	3.20000
			Totals:			50.8288	50.9576
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	2.00000	0.04000	0.20000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	6.00000	0.07800	0.60000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	15.0000	1.95000	10.5000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	1.00000	0.45700	0.43500
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	2.00000	2.08500	2.08500
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	1.00000	0.02000	0.10000
			Totals:			4.86640	15.8124
				Grand Total		6567.06	75.9351

MATERIALS REQUIRED BASED ON

SCENARIO NUMBER 3

Material Requirements								
Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Ad. Automated Directional	Air	G	175.000	0.22400	2.00000	350.000	0.44800
Ad. Automated Directional	Argon	G	175.000	0.31150	2.00000	350.000	0.62300
Electroepitaxial Crystal Growth	GN2	G	83.0000	0.00750	7.00000	581.000	0.05250
High Temperature Acoustic	GN2	G	90.0000	0.11570	17.0000	1530.00	1.96690
Multiple Experiment Processing	Air	G	175.000	0.22400	7.00000	1225.00	1.56800
Multiple Experiment Processing	Argon	G	175.000	0.31150	7.00000	1225.00	2.18050
Multiple Experiment Processing	Helium	G	4.00000	0.00071	7.00000	28.0000	0.00497
Normal Freezing Furnace-1	Air	G	175.000	0.22400	2.00000	350.000	0.44800
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	2.00000	350.000	0.62300
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	1.00000	1.68000	0.00299
			Totals:			5990.68	7.91786
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	2.00000	1.00000	1.00000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	2.00000	4.00000	4.00000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	3.00000	0.38640	0.77280
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	2.00000	2.00000	2.00000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	3.00000	12.0000	12.0000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	7.00000	3.50000	3.50000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	7.00000	14.0000	14.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	2.00000	1.00000	1.00000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	2.00000	4.00000	4.00000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	32.0000	3.20000	3.20000
			Totals:			45.0864	45.4728
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	2.00000	0.15760	1.26160
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	6.00000	0.12000	0.60000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	12.0000	0.15600	1.20000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	3.00000	0.23640	1.89240
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	7.00000	0.91000	4.90000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	2.00000	0.15760	1.26160
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	3.00000	1.37100	1.30500
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	4.00000	4.17000	4.17000
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	2.00000	0.04000	0.20000
			Totals:			7.31860	16.7906
					Grand Total	6043.09	70.1813

MATERIALS REQUIRED BASED ON
SCENARIO NUMBER 4

Material Requirements

Facility	Material	S:Solid L:Liquid G:Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Ad. Automated Directional	Air	G	175.000	0.22400	2.00000	350.000	0.44800
Ad. Automated Directional	Argon	G	175.000	0.31150	2.00000	350.000	0.62300
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	11.0000	913.000	0.08250
High Temperature Acoustic	GN2	G	90.0000	0.11570	17.0000	1530.00	1.96690
Multiple Experiment Processing	Air	G	175.000	0.22400	13.0000	2275.00	2.91200
Multiple Experiment Processing	Argon	G	175.000	0.31150	13.0000	2275.00	4.04950
Multiple Experiment Processing	Helium	G	4.00000	0.00071	13.0000	52.0000	0.00923
Normal Freezing Furnace-1	Air	G	175.000	0.22400	2.00000	350.000	0.44800
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	2.00000	350.000	0.62300
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	1.00000	1.68000	0.00299
			Totals:			8446.68	11.1651
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	2.00000	1.00000	1.00000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	2.00000	4.00000	4.00000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	3.00000	0.38640	0.77280
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	2.00000	2.00000	2.00000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	3.00000	12.0000	12.0000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	13.0000	6.50000	6.50000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	13.0000	26.0000	26.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	2.00000	1.00000	1.00000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	2.00000	4.00000	4.00000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	55.0000	5.50000	5.50000
			Totals:			62.3864	62.7728
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	2.00000	0.15760	1.26160
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	6.00000	0.12000	0.60000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	12.0000	0.15600	1.20000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	3.00000	0.23640	1.89240
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	13.0000	1.69000	9.10000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	2.00000	0.15760	1.26160
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	3.00000	1.37100	1.30500
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	4.00000	4.17000	4.17000
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	2.00000	0.04000	0.20000
			Totals:			8.09860	20.9906
				Grand Total		8517.16	94.9285

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MATERIALS REQUIRED BASED ON

SCENARIO NUMBER 5

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Ad. Automated Directional	Air	G	175.000	0.22400	1.00000	175.000	0.22400
Ad. Automated Directional	Argon	G	175.000	0.31150	1.00000	175.000	0.31150
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	6.00000	498.000	0.04500
High Temperature Acoustic	GN2	G	90.0000	0.11570	0.00000	0.00000	0.00000
Multiple Experiment Processing	Air	G	175.000	0.22400	9.00000	1575.00	2.01600
Multiple Experiment Processing	Argon	G	175.000	0.31150	9.00000	1575.00	2.80350
Multiple Experiment Processing	Helium	G	4.00000	0.00071	9.00000	36.0000	0.00639
Normal Freezing Furnace-1	Air	G	175.000	0.22400	1.00000	175.000	0.22400
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	1.00000	175.000	0.31150
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	2.00000	3.36000	0.00598
			Totals:			4387.36	5.94787
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	1.00000	0.50000	0.50000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	1.00000	2.00000	2.00000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	1.00000	0.12880	0.25760
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	1.00000	1.00000	1.00000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	1.00000	4.00000	4.00000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	9.00000	4.50000	4.50000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	9.00000	18.0000	18.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	1.00000	0.50000	0.50000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	1.00000	2.00000	2.00000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	20.0000	2.00000	2.00000
			Totals:			34.6288	34.7576
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	2.00000	0.04000	0.20000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	6.00000	0.07800	0.60000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	9.00000	1.17000	6.30000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	1.00000	0.45700	0.43500
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	2.00000	2.08500	2.08500
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	1.00000	0.02000	0.10000
			Totals:			4.08640	11.6124
				Grand Total		4426.07	52.3179

MATERIALS REQUIRED BASED ON

SCENARIO NUMBER 6

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Ad. Automated Directional	Air	G	175.000	0.22400	1.00000	175.000	0.22400
Ad. Automated Directional	Argon	G	175.000	0.31150	1.00000	175.000	0.31150
Electroepitaxial Crystal Growth	GN2	G	83.0000	0.00750	6.00000	498.000	0.04500
High Temperature Acoustic	GN2	G	90.0000	0.11570	0.00000	0.00000	0.00000
Multiple Experiment Processing	Air	G	175.000	0.22400	15.0000	2625.00	3.36000
Multiple Experiment Processing	Argon	G	175.000	0.31150	15.0000	2625.00	4.67250
Multiple Experiment Processing	Helium	G	4.00000	0.00071	15.0000	60.0000	0.01065
Normal Freezing Furnace-1	Air	G	175.000	0.22400	1.00000	175.000	0.22400
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	1.00000	175.000	0.31150
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	2.00000	3.36000	0.00598
			Totals:			6511.36	9.16513
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	1.00000	0.50000	0.50000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	1.00000	2.00000	2.00000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	1.00000	0.12880	0.25760
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	1.00000	1.00000	1.00000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	1.00000	4.00000	4.00000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	15.0000	7.50000	7.50000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	15.0000	30.0000	30.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	1.00000	0.50000	0.50000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	1.00000	2.00000	2.00000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	32.0000	3.20000	3.20000
			Totals:			50.8288	50.9576
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	2.00000	0.04000	0.20000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	6.00000	0.07800	0.60000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	15.0000	1.95000	10.5000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	1.00000	0.45700	0.43500
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	2.00000	2.08500	2.08500
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	1.00000	0.02000	0.10000
			Totals:			4.86640	15.8124
				Grand Total		6567.06	75.9351

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MATERIALS REQUIRED BASED ON

SCENARIO NUMBER 7

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Ad. Automated Directional	Air	G	175.000	0.22400	2.00000	350.000	0.44800
Ad. Automated Directional	Argon	G	175.000	0.31150	2.00000	350.000	0.62300
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	9.00000	747.000	0.06750
High Temperature Acoustic	GN2	G	90.0000	0.11570	17.0000	1530.00	1.96690
Multiple Experiment Processing	Air	G	175.000	0.22400	7.00000	1225.00	1.56800
Multiple Experiment Processing	Argon	G	175.000	0.31150	7.00000	1225.00	2.18050
Multiple Experiment Processing	Helium	G	4.00000	0.00071	7.00000	28.0000	0.00497
Normal Freezing Furnace-1	Air	G	175.000	0.22400	2.00000	350.000	0.44800
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	2.00000	350.000	0.62300
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	1.00000	1.68000	0.00299
			Totals:			6156.68	7.93286
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	2.00000	1.00000	1.00000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	2.00000	4.00000	4.00000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	3.00000	0.38640	0.77280
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	2.00000	2.00000	2.00000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	3.00000	12.0000	12.0000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	7.00000	3.50000	3.50000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	7.00000	14.0000	14.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	2.00000	1.00000	1.00000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	2.00000	4.00000	4.00000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	31.0000	3.10000	3.10000
			Totals:			44.9864	45.3728
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	2.00000	0.15760	1.26160
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	6.00000	0.12000	0.60000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	12.0000	0.15600	1.20000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	3.00000	0.23640	1.89240
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	7.00000	0.91000	4.90000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	2.00000	0.15760	1.26160
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	3.00000	1.37100	1.30500
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	4.00000	4.17000	4.17000
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	2.00000	0.04000	0.20000
			Totals:			7.31860	16.7906
				Grand Total		6208.99	70.0963

MATERIALS REQUIRED BASED ON

SCENARIO NUMBER 8

Material Requirements

Facility	Material	S:Solid L:Liquid G:Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Ad. Automated Directional	Air	G	175.000	0.22400	2.00000	350.000	0.44800
Ad. Automated Directional	Argon	G	175.000	0.31150	2.00000	350.000	0.62300
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	12.0000	996.000	0.09000
High Temperature Acoustic	GN2	G	90.0000	0.11570	17.0000	1530.00	1.96690
Multiple Experiment Processing	Air	G	175.000	0.22400	13.0000	2275.00	2.91200
Multiple Experiment Processing	Argon	G	175.000	0.31150	13.0000	2275.00	4.04950
Multiple Experiment Processing	Helium	G	4.00000	0.00071	13.0000	52.0000	0.00923
Normal Freezing Furnace-1	Air	G	175.000	0.22400	2.00000	350.000	0.44800
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	2.00000	350.000	0.62300
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	1.00000	1.68000	0.00299
			Totals:			8529.68	11.1726
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	2.00000	1.00000	1.00000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	2.00000	4.00000	4.00000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	3.00000	0.38640	0.77280
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	2.00000	2.00000	2.00000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	3.00000	12.0000	12.0000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	13.0000	6.50000	6.50000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	13.0000	26.0000	26.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	2.00000	1.00000	1.00000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	2.00000	4.00000	4.00000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	54.0000	5.40000	5.40000
			Totals:			62.2864	62.6728
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	2.00000	0.15760	1.26160
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	6.00000	0.12000	0.60000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	12.0000	0.15600	1.20000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	3.00000	0.23640	1.89240
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	13.0000	1.69000	9.10000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	2.00000	0.15760	1.26160
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	3.00000	1.37100	1.30500
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	4.00000	4.17000	4.17000
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	2.00000	0.04000	0.20000
			Totals:			8.09860	20.9906
					Grand Total	8600.07	94.8360

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MATERIALS REQUIRED BASED ON

SCENARIO NUMBER 9

Material Requirements

Facility	Material	S:Solid L:Liquid G:Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Ad. Automated Directional	Air	G	175.000	0.22400	1.00000	175.000	0.22400
Ad. Automated Directional	Argon	G	175.000	0.31150	1.00000	175.000	0.31150
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	6.00000	498.000	0.04500
High Temperature Acoustic	GN2	G	90.0000	0.11570	0.00000	0.00000	0.00000
Multiple Experiment Processing	Air	G	175.000	0.22400	11.0000	1925.00	2.46400
Multiple Experiment Processing	Argon	G	175.000	0.31150	11.0000	1925.00	3.42650
Multiple Experiment Processing	Helium	G	4.00000	0.00071	11.0000	44.0000	0.00781
Normal Freezing Furnace-1	Air	G	175.000	0.22400	1.00000	175.000	0.22400
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	1.00000	175.000	0.31150
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	2.00000	3.36000	0.00598
			Totals:			5095.36	7.02029
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	1.00000	0.50000	0.50000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	1.00000	2.00000	2.00000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	1.00000	0.12880	0.25760
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	1.00000	1.00000	1.00000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	1.00000	4.00000	4.00000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	11.0000	5.50000	5.50000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	11.0000	22.0000	22.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	1.00000	0.50000	0.50000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	1.00000	2.00000	2.00000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	23.0000	2.30000	2.30000
			Totals:			39.9288	40.0576
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	2.00000	0.04000	0.20000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	6.00000	0.07800	0.60000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	11.0000	1.43000	7.70000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	1.00000	0.45700	0.43500
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	2.00000	2.08500	2.08500
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	1.00000	0.02000	0.10000
			Totals:			4.34640	13.0124
					Grand Total	5139.63	60.0903

MATERIALS REQUIRED BASED ON

SCENARIO NUMBER 10

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Ad. Automated Directional	Air	G	175.000	0.22400	1.00000	175.000	0.22400
Ad. Automated Directional	Argon	G	175.000	0.31150	1.00000	175.000	0.31150
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	6.00000	498.000	0.04500
High Temperature Acoustic	GN2	G	90.0000	0.11570	0.00000	0.00000	0.00000
Multiple Experiment Processing	Air	G	175.000	0.22400	18.0000	3150.00	4.03200
Multiple Experiment Processing	Argon	G	175.000	0.31150	18.0000	3150.00	5.60700
Multiple Experiment Processing	Helium	G	4.00000	0.00071	18.0000	72.0000	0.01278
Normal Freezing Furnace-1	Air	G	175.000	0.22400	1.00000	175.000	0.22400
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	1.00000	175.000	0.31150
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	2.00000	3.36000	0.00598
			Totals:			7573.36	10.7738
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	1.00000	0.50000	0.50000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	1.00000	2.00000	2.00000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	1.00000	0.12880	0.25760
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	1.00000	1.00000	1.00000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	1.00000	4.00000	4.00000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	18.0000	9.00000	9.00000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	18.0000	36.0000	36.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	1.00000	0.50000	0.50000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	1.00000	2.00000	2.00000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	35.0000	3.50000	3.50000
			Totals:			58.6288	58.7576
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	2.00000	0.04000	0.20000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	6.00000	0.07800	0.60000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	18.0000	2.34000	12.6000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	1.00000	0.07880	0.63080
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	1.00000	0.45700	0.43500
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	2.00000	2.08500	2.08500
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	1.00000	0.02000	0.10000
			Totals:			5.25640	17.9124
					Grand Total	7637.24	87.4437

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MATERIALS REQUIRED BASED ON

SCENARIO NUMBER 11

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	2.00000	3.36000	0.00598
Ad. Automated Directional	Air	G	175.000	0.22400	7.00000	1225.00	1.56800
Ad. Automated Directional	Argon	G	175.000	0.31150	7.00000	1225.00	2.18050
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	6.00000	498.000	0.04500
High Temperature Acoustic	GN2	G	90.0000	0.11570	0.00000	0.00000	0.00000
Multiple Experiment Processing	Air	G	175.000	0.22400	9.00000	1575.00	2.01600
Multiple Experiment Processing	Argon	G	175.000	0.31150	9.00000	1575.00	2.80350
Multiple Experiment Processing	Helium	G	4.00000	0.00071	9.00000	36.0000	0.00639
Normal Freezing Furnace-1	Air	G	175.000	0.22400	10.0000	1750.00	2.24000
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	10.0000	1750.00	3.11500
			Totals:			9637.36	13.9804
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	7.00000	3.50000	3.50000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	7.00000	14.0000	14.0000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	13.0000	1.67440	3.34880
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	14.0000	14.0000	14.0000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	9.00000	4.50000	4.50000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	9.00000	18.0000	18.0000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	2.00000	8.00000	8.00000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	10.0000	5.00000	5.00000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	10.0000	20.0000	20.0000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	16.0000	1.60000	1.60000
			Totals:			90.2744	91.9488
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	7.00000	0.55160	4.41560
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	28.0000	0.56000	2.80000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	3.00000	0.03900	0.30000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	15.0000	1.18200	9.46200
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	9.00000	1.17000	6.30000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	10.0000	0.78800	6.30800
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	10.0000	4.57000	4.35000
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	13.0000	13.5525	13.5525
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	12.0000	0.24000	1.20000
			Totals:			22.6531	48.6881
				Grand Total		9750.29	154.617

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MATERIALS REQUIRED BASED ON
SCENARIO NUMBER 12

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	2.00000	3.36000	0.00598
Ad. Automated Directional	Air	G	175.000	0.22400	14.0000	2450.00	3.13600
Ad. Automated Directional	Argon	G	175.000	0.31150	14.0000	2450.00	4.36100
Electroepitaxial Crystal Growth	GN2	G	83.0000	0.00750	6.00000	498.000	0.04500
High Temperature Acoustic	GN2	G	90.0000	0.11570	0.00000	0.00000	0.00000
Multiple Experiment Processing	Air	G	175.000	0.22400	14.0000	2450.00	3.13600
Multiple Experiment Processing	Argon	G	175.000	0.31150	14.0000	2450.00	4.36100
Multiple Experiment Processing	Helium	G	4.00000	0.00071	14.0000	56.0000	0.00994
Normal Freezing Furnace-1	Air	G	175.000	0.22400	20.0000	3500.00	4.48000
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	20.0000	3500.00	6.23000
			Totals:			17357.4	25.7649
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	14.0000	7.00000	7.00000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	14.0000	28.0000	28.0000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	20.0000	2.57600	5.15200
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	25.0000	25.0000	25.0000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	14.0000	7.00000	7.00000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	14.0000	28.0000	28.0000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	2.00000	8.00000	8.00000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	20.0000	10.0000	10.0000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	20.0000	40.0000	40.0000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	30.0000	3.00000	3.00000
			Totals:			158.576	161.152
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	14.0000	1.10320	8.83120
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	44.0000	0.88000	4.40000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	6.00000	0.07800	0.60000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	15.0000	1.18200	9.46200
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	14.0000	1.82000	9.80000
Normal Freezing Furnace-1	Seniconductor Matl.	S	0.07880	0.63080	20.0000	1.57600	12.6160
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	18.0000	8.22600	7.83000
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	20.0000	20.8500	20.8500
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	21.0000	0.42000	2.10000
			Totals:			36.1352	76.4892
					Grand Total	17552.1	263.406

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MATERIALS REQUIRED BASED ON
SCENARIO NUMBER 13

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	16.0000	26.8800	0.04784
Ad. Automated Directional	Air	G	175.000	0.22400	7.00000	1225.00	1.56800
Ad. Automated Directional	Argon	G	175.000	0.31150	7.00000	1225.00	2.18050
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	7.00000	581.000	0.05250
High Temperature Acoustic	GN2	G	90.0000	0.11570	3.00000	270.000	0.34710
Multiple Experiment Processing	Air	G	175.000	0.22400	5.00000	875.000	1.12000
Multiple Experiment Processing	Argon	G	175.000	0.31150	5.00000	875.000	1.55750
Multiple Experiment Processing	Helium	G	4.00000	0.00071	5.00000	20.0000	0.00355
Normal Freezing Furnace-1	Air	G	175.000	0.22400	8.00000	1400.00	1.79200
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	8.00000	1400.00	2.49200
			Totals:			7897.88	11.1610
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	7.00000	3.50000	3.50000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	7.00000	14.0000	14.0000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	13.0000	1.67440	3.34880
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	6.00000	6.00000	6.00000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	5.00000	2.50000	2.50000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	5.00000	10.0000	10.0000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	4.00000	16.0000	16.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	8.00000	4.00000	4.00000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	8.00000	16.0000	16.0000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	18.0000	1.80000	1.80000
			Totals:			75.4744	77.1488
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	7.00000	0.55160	4.41560
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	14.0000	0.28000	1.40000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	4.00000	0.05200	0.40000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	45.0000	3.54600	28.3860
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	5.00000	0.65000	3.50000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	8.00000	0.63040	5.04640
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	12.0000	5.48400	5.22000
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	16.0000	16.6800	16.6800
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	12.0000	0.24000	1.20000
			Totals:			28.1140	66.2480
				Grand Total		8001.47	154.558

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MATERIALS REQUIRED BASED ON

SCENARIO NUMBER 14

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	16.0000	26.8800	0.04784
Ad. Automated Directional	Air	G	175.000	0.22400	12.0000	2100.00	2.68800
Ad. Automated Directional	Argon	G	175.000	0.31150	12.0000	2100.00	3.73800
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	7.00000	581.000	0.05250
High Temperature Acoustic	GN2	G	90.0000	0.11570	11.0000	990.000	1.27270
Multiple Experiment Processing	Air	G	175.000	0.22400	12.0000	2100.00	2.68800
Multiple Experiment Processing	Argon	G	175.000	0.31150	12.0000	2100.00	3.73800
Multiple Experiment Processing	Helium	G	4.00000	0.00071	12.0000	48.0000	0.00852
Normal Freezing Furnace-1	Air	G	175.000	0.22400	16.0000	2800.00	3.58400
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	16.0000	2800.00	4.98400
				Totals:		15645.9	22.8016
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	12.0000	6.00000	6.00000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	12.0000	24.0000	24.0000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	26.0000	3.34880	6.69760
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	24.0000	24.0000	24.0000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	12.0000	6.00000	6.00000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	12.0000	24.0000	24.0000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	4.00000	16.0000	16.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	16.0000	8.00000	8.00000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	16.0000	32.0000	32.0000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	34.0000	3.40000	3.40000
				Totals:		146.749	150.098
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	12.0000	0.94560	7.56960
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	49.0000	0.98000	4.90000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	8.00000	0.10400	0.80000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	45.0000	3.54600	28.3860
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	12.0000	1.56000	8.40000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	16.0000	1.26080	10.0928
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	20.0000	9.14000	8.70000
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	27.0000	28.1475	28.1475
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	19.0000	0.38000	1.90000
				Totals:		46.0639	98.8959
					Grand Total	15838.7	271.795

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MATERIALS REQUIRED BASED ON
SCENARIO NUMBER 15

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	2.00000	3.36000	0.00598
Ad. Automated Directional	Air	G	175.000	0.22400	8.00000	1400.00	1.79200
Ad. Automated Directional	Argon	G	175.000	0.31150	8.00000	1400.00	2.49200
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	6.00000	498.000	0.04500
High Temperature Acoustic	GN2	G	90.0000	0.11570	0.00000	0.00000	0.00000
Multiple Experiment Processing	Air	G	175.000	0.22400	8.00000	1400.00	1.79200
Multiple Experiment Processing	Argon	G	175.000	0.31150	8.00000	1400.00	2.49200
Multiple Experiment Processing	Helium	G	4.00000	0.00071	8.00000	32.0000	0.00568
Normal Freezing Furnace-1	Air	G	175.000	0.22400	11.0000	1925.00	2.46400
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	11.0000	1925.00	3.42650
			Totals:			9983.36	14.5152
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	8.00000	4.00000	4.00000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	8.00000	16.0000	16.0000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	13.0000	1.67440	3.34880
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	16.0000	16.0000	16.0000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	8.00000	4.00000	4.00000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	8.00000	16.0000	16.0000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	2.00000	8.00000	8.00000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	11.0000	5.50000	5.50000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	11.0000	22.0000	22.0000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	18.0000	1.80000	1.80000
			Totals:			94.9744	96.6488
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	8.00000	0.63040	5.04640
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	24.0000	0.48000	2.40000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	6.00000	0.07800	0.60000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	15.0000	1.18200	9.46200
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	8.00000	1.04000	5.60000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	11.0000	0.86680	6.93880
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	11.0000	5.02700	4.78500
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	13.0000	13.5525	13.5525
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	12.0000	0.24000	1.20000
			Totals:			23.0967	49.5847
					Grand Total	10101.4	160.749

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MATERIALS REQUIRED BASED ON
SCENARIO NUMBER 16

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	2.00000	3.36000	0.00596
Ad. Automated Directional	Air	G	175.000	0.22400	13.0000	2275.00	2.91200
Ad. Automated Directional	Argon	G	175.000	0.31150	13.0000	2275.00	4.04950
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	6.00000	498.000	0.04500
High Temperature Acoustic	GN2	G	90.0000	0.11570	0.00000	0.00000	0.00000
Multiple Experiment Processing	Air	G	175.000	0.22400	15.0000	2625.00	3.36000
Multiple Experiment Processing	Argon	G	175.000	0.31150	15.0000	2625.00	4.67250
Multiple Experiment Processing	Helium	G	4.00000	0.00071	15.0000	60.0000	0.01065
Normal Freezing Furnace-1	Air	G	175.000	0.22400	19.0000	3325.00	4.25600
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	19.0000	3325.00	5.91850
			Totals:			17011.4	25.2301
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	13.0000	6.50000	6.50000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	13.0000	26.0000	26.0000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	20.0000	2.57600	5.15200
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	29.0000	29.0000	29.0000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	15.0000	7.50000	7.50000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	15.0000	30.0000	30.0000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	2.00000	8.00000	8.00000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	19.0000	9.50000	9.50000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	19.0000	38.0000	38.0000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	29.0000	2.90000	2.90000
			Totals:			159.976	162.552
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	13.0000	1.02440	8.20040
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	50.0000	1.00000	5.00000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	6.00000	0.07800	0.60000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	15.0000	1.18200	9.46200
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	15.0000	1.95000	10.5000
Normal Freezing Furnace-1	Seniconductor Matl.	S	0.07880	0.63080	19.0000	1.49720	11.9852
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	18.0000	8.22600	7.83000
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	21.0000	21.8925	21.8925
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	21.0000	0.42000	2.10000
			Totals:			37.2701	77.5701
					Grand Total	17208.6	265.352

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MATERIALS REQUIRED BASED ON
SCENARIO NUMBER 17

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	16.0000	26.8800	0.04784
Ad. Automated Directional	Air	G	175.000	0.22400	7.00000	1225.00	1.56800
Ad. Automated Directional	Argon	G	175.000	0.31150	7.00000	1225.00	2.18050
Electroepitaxial Crystal Growth	GN2	G	83.0000	0.00750	7.00000	581.000	0.05250
High Temperature Acoustic	GN2	G	90.0000	0.11570	11.0000	990.000	1.27270
Multiple Experiment Processing	Air	G	175.000	0.22400	6.00000	1050.00	1.34400
Multiple Experiment Processing	Argon	G	175.000	0.31150	6.00000	1050.00	1.86900
Multiple Experiment Processing	Helium	G	4.00000	0.00071	6.00000	24.0000	0.00426
Normal Freezing Furnace-1	Air	G	175.000	0.22400	7.00000	1225.00	1.56800
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	7.00000	1225.00	2.18050
			Totals:			8621.88	12.0873
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	7.00000	3.50000	3.50000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	7.00000	14.0000	14.0000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	13.0000	1.67440	3.34880
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	15.0000	15.0000	15.0000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	6.00000	3.00000	3.00000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	6.00000	12.0000	12.0000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	4.00000	16.0000	16.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	7.00000	3.50000	3.50000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	7.00000	14.0000	14.0000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	18.0000	1.80000	1.80000
			Totals:			84.4744	86.1488
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	7.00000	0.55160	4.41560
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	23.0000	0.46000	2.30000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	7.00000	0.09100	0.70000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	45.0000	3.54600	28.3860
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	6.00000	0.78000	4.20000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	7.00000	0.55160	4.41560
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	11.0000	5.02700	4.78500
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	15.0000	15.6375	15.6375
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	8.00000	0.16000	0.80000
			Totals:			26.8047	65.6397
					Grand Total	8733.16	163.876

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MATERIALS REQUIRED BASED ON

SCENARIO NUMBER 1B

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	16.0000	26.8800	0.04784
Ad. Automated Directional	Air	G	175.000	0.22400	13.0000	2275.00	2.91200
Ad. Automated Directional	Argon	G	175.000	0.31150	13.0000	2275.00	4.04950
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	7.00000	581.000	0.05250
High Temperature Acoustic	GN2	G	90.0000	0.11570	22.0000	1980.00	2.54540
Multiple Experiment Processing	Air	G	175.000	0.22400	12.0000	2100.00	2.68800
Multiple Experiment Processing	Argon	G	175.000	0.31150	12.0000	2100.00	3.73800
Multiple Experiment Processing	Helium	G	4.00000	0.00071	12.0000	48.0000	0.00852
Normal Freezing Furnace-1	Air	G	175.000	0.22400	17.0000	2975.00	3.80800
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	17.0000	2975.00	5.29550
			Totals:			17335.9	25.1453
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	13.0000	6.50000	6.50000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	13.0000	26.0000	26.0000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	22.0000	2.83360	5.66720
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	23.0000	23.0000	23.0000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	12.0000	6.00000	6.00000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	12.0000	24.0000	24.0000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	4.00000	16.0000	16.0000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	17.0000	8.50000	8.50000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	17.0000	34.0000	34.0000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	33.0000	3.30000	3.30000
			Totals:			150.134	152.967
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	13.0000	1.02440	8.20040
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	42.0000	0.84000	4.20000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	8.00000	0.10400	0.80000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	45.0000	3.54600	28.3860
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	12.0000	1.56000	8.40000
Normal Freezing Furnace-1	Seniconductor Matl.	S	0.07880	0.63080	17.0000	1.33960	10.7236
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	20.0000	9.14000	8.70000
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	23.0000	23.9775	23.9775
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	20.0000	0.40000	2.00000
			Totals:			41.9315	95.3875
					Grand Total	17527.9	273.500

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MATERIALS REQUIRED BASED ON
SCENARIO NUMBER 19

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	2.00000	3.36000	0.00598
Ad. Automated Directional	Air	G	175.000	0.22400	11.0000	1925.00	2.46400
Ad. Automated Directional	Argon	G	175.000	0.31150	11.0000	1925.00	3.42650
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	6.00000	498.000	0.04500
High Temperature Acoustic	GN2	G	90.0000	0.11570	0.00000	0.00000	0.00000
Multiple Experiment Processing	Air	G	175.000	0.22400	11.0000	1925.00	2.46400
Multiple Experiment Processing	Argon	G	175.000	0.31150	11.0000	1925.00	3.42650
Multiple Experiment Processing	Helium	G	4.00000	0.00071	11.0000	44.0000	0.00781
Normal Freezing Furnace-1	Air	G	175.000	0.22400	17.0000	2975.00	3.80800
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	17.0000	2975.00	5.29550
					Totals:	14195.4	20.9433
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	11.0000	5.50000	5.50000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	11.0000	22.0000	22.0000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	16.0000	2.06080	4.12160
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	43.0000	43.0000	43.0000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	11.0000	5.50000	5.50000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	11.0000	22.0000	22.0000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	2.00000	8.00000	8.00000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	17.0000	8.50000	8.50000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	17.0000	34.0000	34.0000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	23.0000	2.30000	2.30000
					Totals:	152.861	154.922
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	11.0000	0.86680	6.93880
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	47.0000	0.94000	4.70000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	6.00000	0.07800	0.60000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	15.0000	1.18200	9.46200
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	11.0000	1.43000	7.70000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	17.0000	1.33960	10.7236
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	14.0000	6.39800	6.09000
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	15.0000	15.6375	15.6375
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	16.0000	0.32000	1.60000
					Totals:	28.1919	63.4519
					Grand Total	14376.4	239.317

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MATERIALS REQUIRED BASED ON
SCENARIO NUMBER 20

Material Requirements

Facility	Material	S=Solid L=Liquid G=Gas	Volume Per Run (liter)	Mass Per Run (kg)	Number of Runs	Material Volume (liter)	Material Mass (kg)
Three Axis Acoustic Levitator	GN2	G	1.68000	0.00299	2.00000	3.36000	0.00598
Ad. Automated Directional	Air	G	175.000	0.22400	16.0000	2800.00	3.58400
Ad. Automated Directional	Argon	G	175.000	0.31150	16.0000	2800.00	4.98400
Electroepitaxial Crystal Growth	GH2	G	83.0000	0.00750	6.00000	498.000	0.04500
High Temperature Acoustic	GN2	G	90.0000	0.11570	0.00000	0.00000	0.00000
Multiple Experiment Processing	Air	G	175.000	0.22400	18.0000	3150.00	4.03200
Multiple Experiment Processing	Argon	G	175.000	0.31150	18.0000	3150.00	5.60700
Multiple Experiment Processing	Helium	G	4.00000	0.00071	18.0000	72.0000	0.01278
Normal Freezing Furnace-1	Air	G	175.000	0.22400	26.0000	4550.00	5.82400
Normal Freezing Furnace-1	Argon	G	175.000	0.31150	26.0000	4550.00	8.09900
			Totals:			21573.4	32.1938
Ad. Automated Directional	Cleaning Fluid	L	0.50000	0.50000	16.0000	8.00000	8.00000
Ad. Automated Directional	Distilled Water	L	2.00000	2.00000	16.0000	32.0000	32.0000
Diffusive Mixing of Organic	Organic Solutions	L	0.12880	0.25760	20.0000	2.57600	5.15200
Fluid Experiment System	Model Fluids	L	1.00000	1.00000	50.0000	50.0000	50.0000
Multiple Experiment Processing	Cleaning Fluid	L	0.50000	0.50000	18.0000	9.00000	9.00000
Multiple Experiment Processing	Distilled water	L	2.00000	2.00000	18.0000	36.0000	36.0000
Moving Wall Electrophoresis Unit	Biomaterial	L	4.00000	4.00000	2.00000	8.00000	8.00000
Normal Freezing Furnace-1	Cleaning Fluid	L	0.50000	0.50000	26.0000	13.0000	13.0000
Normal Freezing Furnace-1	Distilled Water	L	2.00000	2.00000	26.0000	52.0000	52.0000
Protein Crystal Growth-IV	Proteins	L	0.10000	0.10000	35.0000	3.50000	3.50000
			Totals:			214.076	216.652
Ad. Automated Directional	Semiconductor Matl.	S	0.07880	0.63080	16.0000	1.26080	10.0928
Chemical Vapor Transport	Semiconductors	S	0.02000	0.10000	50.0000	1.00000	5.00000
Electromagnetic Levitator	Metals and Alloys	S	0.01300	0.10000	6.00000	0.07800	0.60000
Float Zone Crystal Growth	Silicon, Semicond.	S	0.07880	0.63080	15.0000	1.18200	9.46200
Multiple Experiment Processing	Metals and Alloys	S	0.13000	0.70000	18.0000	2.34000	12.6000
Normal Freezing Furnace-1	Semiconductor Matl.	S	0.07880	0.63080	26.0000	2.04880	16.4008
Organic and Polymer Crystal	Organic Solutions	S	0.45700	0.43500	20.0000	9.14000	8.70000
Physical Vapor Transport of	Organic Solutions	S	1.04250	1.04250	21.0000	21.8925	21.8925
Vapor Crystal Growth System	Semiconductors	S	0.02000	0.10000	25.0000	0.50000	2.50000
			Totals:			39.4421	87.2481
				Grand Total		21826.9	336.094

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SUMMARY OF SCENARIOS SF1 THRU SF10

Scenario Number	Average Power	Average Thermal	Average Data	Gaseous Logistic Mass (kg)	Liquid Logistic Mass (kg)	Solid Logistic Mass (kg)	Total Logistic Mass (kg)	Gaseous Logistic Vol. (l)	Liquid Logistic Vol. (l)	Solid Logistic Vol. (l)	Total Logistic Vol. (l)
SF-1*	4.542	4.544	2.266	19.2426	290.42	1.50665	311.1692	22686	290.42	30.01167	23006.43
SF-2*	4.023	4.024	1.982	22.273	310.47	1.50696	334.2499	24973	310.47	30.012	25313.48
SF-3*	4.835	4.838	3.106	24.903	548.84	3.01228	576.7552	29913	675.91	60.0223	30648.93
SF-4*	4.604	4.606	3.205	37.3332	606.45	3.01324	646.7964	42670	733.52	60.0233	43463.54
SF-5*	4.215	4.216	2.243	18.9169	282.83	1.50655	303.2534	22455	282.83	30.0115	22767.84
SF-6*	4.227	4.228	1.913	22.2686	309.67	1.50695	333.4455	24958	309.67	30.012	25297.68
SF-7*	4.61	4.611	2.88	23.3969	541.23	3.01222	567.6391	28148	668.3	60.0223	28876.32
SF-8*	4.623	4.625	3.314	36.396	589.27	3.01307	628.6790	38745	716.34	60.0231	39521.36
SF-9*	6.787	6.791	2.883	23.0262	335.27	1.50724	359.8034	25576	335.27	30.0123	25941.28
SF-10*	4.858	4.861	1.989	23.1601	336.27	1.50727	360.9373	25666	336.27	30.0123	26032.28
Average	4.7324	4.7344	2.578	25.09165	415.072	2.109243	442.2728	28579	465.9	42.01627	29086.91
Standard Devation	0.731693	0.732539	0.524685	6.138419	129.7827	0.737671	135.5813	6478.568	191.3512	14.70222	6654.135
Maximun	6.787	6.791	3.314	37.3332	606.45	3.01324	646.7964	42670	733.52	60.0233	43463.54
Minimum	4.023	4.024	1.913	18.9169	282.83	1.50655	303.2534	22455	282.83	30.0115	22767.84

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SUMMARY OF SCENARIOS 1 THRU 10

Scenario Number	Average Power	Average Thermal	Average Data	Gaseous Logistic Mass (kg)	Liquid Logistic Mass (kg)	Solid Logistic Mass (kg)	Total Logistic Mass (kg)	Gaseous Logistic Vol. (l)	Liquid Logistic Vol. (l)	Solid Logistic Vol. (l)	Total Logistic Vol. (l)
1	2.68	2.6557	16.73	5.94787	34.7576	11.6124	52.31787	4387.36	34.6288	4.0864	4426.075
2	2.049	2.0273	16.19	9.16513	50.9576	15.8124	75.93513	6511.36	50.8288	4.8664	6567.055
3	4.0839	4.0224	24.31	7.91786	45.4728	16.7906	70.18126	5990.68	45.0864	7.3186	6043.085
4	3.7131	3.6703	24.58	11.1651	62.7728	20.9906	94.9285	8446.68	62.3864	8.0986	8517.165
5	2.6802	2.656	16.32	5.94787	34.7576	11.6124	52.31787	4387.36	34.6288	4.0864	4426.075
6	2.049	2.0266	15.996	9.16513	50.9576	15.8124	75.93513	6511.36	50.8288	4.8664	6567.055
7	4.5758	4.5181	23.73	7.93286	45.3728	16.7906	70.09626	6156.68	44.9864	7.3186	6208.985
8	3.8742	3.8311	24.19	11.1726	62.6728	20.9906	94.836	8529.68	62.2864	8.0986	8600.065
9	2.9031	2.7745	13.39	7.02029	40.0576	13.0124	60.09029	5095.36	39.9288	4.3464	5139.635
10	2.1638	2.1429	12.58	10.7738	58.7576	17.9124	87.4438	7573.36	58.6288	5.2564	7637.245
Average	3.07721	3.03249	18.8016	8.620851	48.65368	16.13368	73.40821	6358.988	48.42184	5.83428	6413.244
Standard Devation	0.973900	0.859965	4.584667	1.898190	9.947700	3.194355	14.90099	1419.135	9.892213	1.587204	1430.128
Maximun	4.5758	4.5181	24.58	11.1726	62.7728	20.9906	94.9285	8529.68	62.3864	8.0986	8600.065
Minimum	2.049	2.0266	12.58	5.94787	34.7576	11.6124	52.31787	4387.36	34.6288	4.0864	4426.075

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SUMMARY OF THE SCENARIOS 11 THRU 20

Scenario Number	Average Power	Average Thermal	Average Data	Gaseous Logistic Mass (kg)	Liquid Logistic Mass (kg)	Solid Logistic Mass (kg)	Total Logistic Mass (kg)	Gaseous Logistic Vol. (l)	Liquid Logistic Vol. (l)	Solid Logistic Vol. (l)	Total Logistic Vol. (l)
11	4.665	4.697	38.12	13.98	91.949	48.688	154.617	9637.36	90.2744	22.6531	9750.287
12	4.633	4.517	44.288	25.765	161.152	76.489	263.406	17357.4	158.576	36.1352	17552.11
13	4.95	4.93	35.235	11.161	77.149	66.248	154.558	7897.88	75.4744	28.114	8001.468
14	4.996	4.991	42.977	22.802	150.098	98.896	271.796	15645.9	146.749	46.0639	15838.71
15	4.804	4.666	39.218	14.515	96.649	49.585	160.749	9983.36	94.9744	23.0967	10101.43
16	4.566	4.56	44.611	25.23	162.552	77.57	265.352	17011.4	159.976	37.2701	17208.64
17	5.315	5.34	33.393	12.087	86.149	65.64	163.876	8621.88	84.4744	26.8047	8733.159
18	5.106	5.136	42.966	25.145	152.967	95.388	273.5	17335.9	150.134	41.9315	17527.96
19	6.307	6.313	55.722	20.943	154.922	63.452	239.317	14195.4	152.861	28.1919	14376.45
20	5.321	5.305	52.616	32.194	216.652	87.248	336.094	21573.4	214.076	39.4421	21826.91
Average	5.0663	5.0455	42.9146	20.3822	135.0239	72.9204	228.3265	13925.98	132.7569	32.97032	14091.71
Standard Devation	0.485179	0.506519	6.702293	6.708961	42.56181	16.54715	61.53193	4391.397	42.15089	7.813440	4438.912
Maximun	6.307	6.313	55.722	32.194	216.652	98.896	336.094	21573.4	214.076	46.0639	21826.91
Minimum	4.566	4.517	33.393	11.161	77.149	48.688	154.558	7897.88	75.4744	22.6531	8001.468

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SUMMARY OF SCENARIOS SF1 THRU SF10
AND SCENARIOS 1 THRU 20

Scenario Number	Average Power	Average Thermal	Average Data	Gaseous Logistic Mass (kg)	Liquid Logistic Mass (kg)	Solid Logistic Mass (kg)	Total Logistic Mass (kg)	Gaseous Logistic Vol. (l)	Liquid Logistic Vol. (l)	Solid Logistic Vol. (l)	Total Logistic Vol. (l)
SF-1*	4.542	4.544	2.266	19.2426	290.42	1.50665	311.1692	22686	290.42	30.01167	23006.43
SF-2*	4.023	4.024	1.982	22.273	310.47	1.50696	334.2499	24973	310.47	30.012	25313.48
SF-3*	4.835	4.838	3.106	24.903	548.84	3.01228	576.7552	29913	675.91	60.0223	30648.93
SF-4*	4.604	4.606	3.205	37.3332	606.45	3.01324	646.7964	42670	733.52	60.0233	43463.54
SF-5*	4.215	4.216	2.243	18.9169	282.83	1.50655	303.2534	22455	282.83	30.0115	22767.34
SF-6*	4.227	4.228	1.913	22.2686	309.67	1.50695	333.4455	24958	309.67	30.012	25297.68
SF-7*	4.61	4.611	2.88	23.3969	541.23	3.01222	567.6391	28148	668.3	60.0223	28876.22
SF-8*	4.623	4.625	3.314	36.396	589.27	3.01307	628.6790	38745	716.34	60.0231	39521.36
SF-9*	6.787	6.791	2.883	23.0262	335.27	1.50724	359.8034	25576	335.27	30.0123	25941.28
SF-10*	4.858	4.861	1.988	23.1601	336.27	1.50727	360.9373	25666	336.27	30.0123	26032.28
1	2.68	2.6557	16.73	5.94787	34.7576	11.6124	52.31787	4387.36	34.6288	4.0864	4426.075
2	2.049	2.0273	16.19	9.16513	50.9576	15.8124	75.93513	6511.36	50.8288	4.8664	6567.055
3	4.0839	4.0224	24.31	7.91786	45.4728	16.7906	70.18126	5990.68	45.0864	7.3186	6043.085
4	3.7131	3.6703	24.58	11.1651	62.7728	20.9906	94.9285	8446.68	62.3864	8.0986	8517.165
5	2.6802	2.656	16.32	5.94787	34.7576	11.6124	52.31787	4387.36	34.6288	4.0864	4426.075
6	2.049	2.0266	15.996	9.16513	50.9576	15.8124	75.93513	6511.36	50.8288	4.8664	6567.055
7	4.5758	4.5181	23.73	7.93286	45.3728	16.7906	70.09626	6156.68	44.9864	7.3186	6208.985
8	3.8742	3.8311	24.19	11.1726	62.6728	20.9906	94.836	8529.68	62.2864	8.0986	8600.065
9	2.8031	2.7745	13.39	7.02029	40.0576	13.0124	60.09029	5095.36	39.9288	4.3464	5139.635
10	2.1638	2.1429	12.58	10.7758	58.7576	17.9124	87.4458	7573.36	58.6288	5.2564	7637.245
11	4.665	4.697	38.12	13.98	91.949	48.688	154.617	9637.36	90.2744	22.6531	9750.287
12	4.633	4.517	44.288	25.765	161.152	76.489	263.406	17357.4	158.576	36.1352	17552.11
13	4.95	4.93	35.235	11.161	77.149	66.248	154.558	7897.88	75.4744	28.114	8001.468
14	4.996	4.991	42.977	22.802	150.098	98.896	271.796	15645.9	146.749	46.0639	15838.71
15	4.804	4.666	39.218	14.515	96.649	49.585	160.749	9983.36	94.9744	23.0967	10101.43
16	4.566	4.56	44.611	25.23	162.552	77.57	265.352	17011.4	159.976	37.2701	17208.64
17	5.315	5.34	33.393	12.087	86.149	65.64	163.876	8621.88	84.4744	26.8047	8733.159
18	5.106	5.136	42.966	25.145	152.967	95.388	273.5	17335.9	150.134	41.9315	17527.96
19	6.307	6.313	55.722	20.943	154.922	63.452	239.317	14195.4	152.861	28.1919	14376.45
20	5.321	5.305	52.616	32.194	216.652	87.248	336.094	21573.4	214.076	39.4421	21826.91
Average	4.288636	4.270796	21.4314	18.03156	199.5831	30.38777	248.0025	16287.99	215.6929	26.94029	16530.62
Standard Devation	1.129608	1.137426	17.22507	8.760237	175.2494	32.12701	174.1664	10303.77	212.8782	18.15520	10519.77
Maximun	6.787	6.791	55.722	37.3332	606.45	98.896	646.7964	42670	733.52	60.0233	43463.54
Minimum	2.049	2.0266	1.913	5.94787	34.7576	1.50655	52.31787	4387.36	34.6288	4.0864	4426.075

* THESE SCENARIOES WERE PERFORMED USING THE MMPF DATA. ALL OTHERS WERE PERFORMED USING EXISTING MPS HARDWARE.

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SAMPLE RETURN ANALYSIS

	EXPERIMENT/ FACILITY	VOLUME	MASS	TEMPERATURE	POWER	COMMENTS
GROUP 1	PCG I PCG II PCG III PCG IV	56.7 l per MDE	9.2 kG per MDE	21.6 C 4.0 C +/-.1 C	100 watts peak per MDE .8 duty cycle	10 MDE's per double rack
GROUP 2	DMOS PVTOS OPCGF	54 l per EAC	58 kg per EAC	20-30 C	50 watts peak per EAC .5 duty cycle	9 EAC's per double rack
GROUP 3	IEF IBSE MWEU CFES	Require early access to samples or the use of a storage technique such as freeze drying or freezing. Current hardware is configured for the middeck and does not account for sample deterioration. Freezing to -20 C may be employed.				
GROUP 4	FES ZCG	26.9 l per test cell	109.2 kg per test cell	<38 C		1 test cell per double rack.